1986-12

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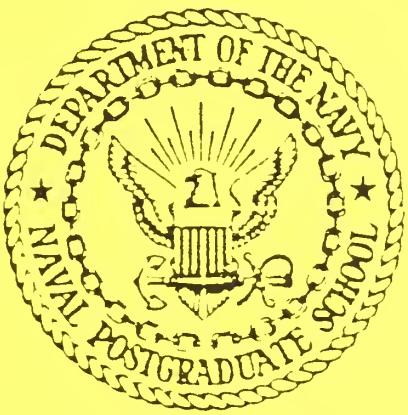
Ciandro, Melissa L.

Monterey, California. Naval Postgraduate School

NPS-68-86-012

NAVAL POSTGRADUATE SCHOOL

Monterey, California



HYDROGRAPHIC DATA FROM THE OPTOMA PROGRAM
OPTOMA22
27 JULY - 5 AUGUST 1986

by

Melissa L. Ciandro
Paul A. Wittmann
Arlene A. Bird
Christopher N. K. Mooers

December 1986

Prepared for:
Office of Naval Research
ironmental Sciences Directorate (Code 1122)
ington, VA 22217

NAVAL POSTGRADUATE SCHOOL

Monterey, California 93943

RADM R. C. Austin
Superintendent

David A. Schrady
Provost

This report is for the research project "Ocean Prediction Through Observations, Modeling and Analysis" sponsored by the Physical Oceanography Program of the Office of Naval Research under Program Element 61153N.

This report was prepared by:

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) NPS-68-86-012	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION NAVPGSCOL Dept. of Oceanography 6b. OFFICE SYMBOL (*If applicable*) 68	7a NAME OF MONITORING ORGANIZATION
6c. ADDRESS (*City, State, and ZIP Code*) Monterey, California 93943-5008	7b. ADDRESS (*City, State, and ZIP Code*)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Office of Naval Research 8b OFFICE SYMBOL (*If applicable*) (1122 PO)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N000146WR24027
8c. ADDRESS (*City, State, and ZIP Code*) Arlington, VA 22217	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 61153N; PROJECT NO RR0310309; TASK NO; WORK UNIT ACCESSION NO.

11. TITLE (*Include Security Classification*)
Hydrographic Data from the OPTOMA Program, 27 July - 5 August, 1986; Approved for public release; distribution unlimited.

12 PERSONAL AUTHOR(S)
Melissa L. Ciandro, Paul A. Wittmann, Arlene A. Bird, Christopher N. K. Mooers

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (*Year, Month, Day*)	15 PAGE COUNT
Progress	FROM Jul 86 TO Aug 86	86 December 28	48

16 SUPPLEMENTARY NOTATION

17 COSATI CODES			18 SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)
FIELD	GROUP	SUB-GROUP	

19 ABSTRACT (*Continue on reverse if necessary and identify by block number*)

The cruise OPTOMA22 was undertaken from the period 27 July to 5 August 1986 to sample a subdomain of the California Current System. This report presents the hydrographic data from the cruise.

DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a NAME OF RESPONSIBLE INDIVIDUAL Melissa L. Ciandro	22b TELEPHONE (*Include Area Code*) (408) 646-3258 22c. OFFICE SYMBOL 68

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

☆U.S. Government Printing Office: 1985—507-047

Hydrographic Data from the **OPTOMA** *Program:*

OPTOMA22

27 July - 5 August, 1986

by

Melissa A. Ciandro
Paul A. Wittmann
Arlene A. Bird
Christopher N. K. Mooers

Chief Scientist:
Gordon W. Groves

The **OPTOMA** Program is a joint program of

Department of Oceanography
Naval Postgraduate School
Monterey, CA 93943.

Center for Earth and Planetary Physics
Harvard University
Cambridge, MA 02138.

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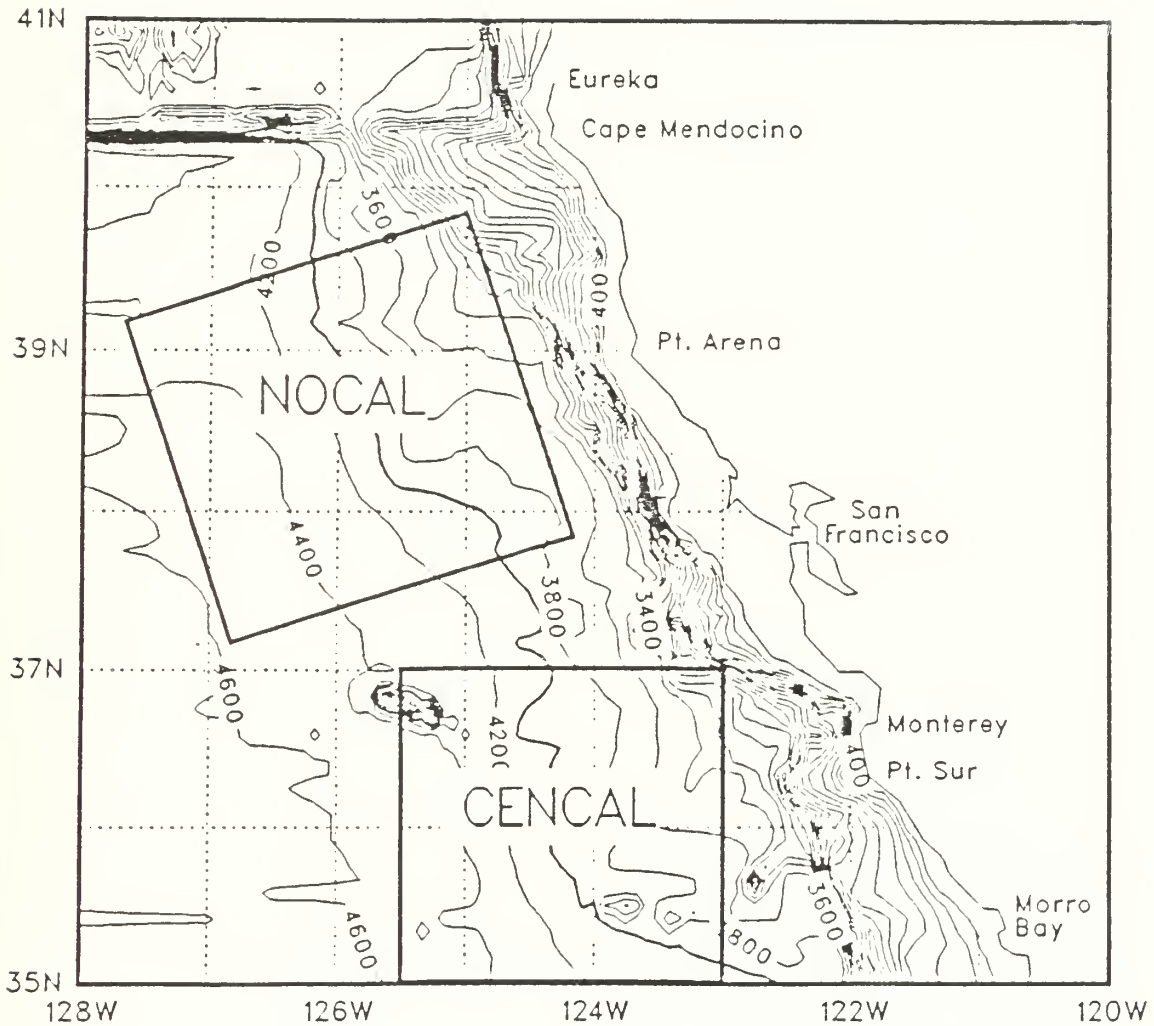


Figure 1: The NOCAL and CENCAL subdomains of the OPTOMA Program. Isobaths are shown in meters.

INTRODUCTION

The OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) Program, a joint NPS/Harvard program sponsored by ONR, seeks to understand the mesoscale (fronts, eddies, and jets) variability and dynamics of the California Current System and to determine the scientific limits to practical mesoscale ocean forecasting. To help carry out the aims of this project, a series of cruises has been planned in two subdomains, NOCAL and CENCAL, shown in Figure 1.

The cruise, OPTOMA22, was undertaken during the period 27 July to 5 August 1986, on the USNS De STEIGUER, and sampled a domain approximately 240km square centered about 280km off the coast between Pt. Arena and Cape Mendocino, as shown in Figure 2. Oceanographic stations were occupied during the period 27 July to 5 August at approximately 18km along each track.

DATA ACQUISITION

Data acquired during OPTOMA22 include XBT and CTD profiles. Bucket surface temperatures, surface water samples for salinity and deep water samples for salinity were taken at each CTD station. The surface and deep water values were used solely for calibration purposes.

The XBT data were digitized using a Sippican MK9 unit; data were recorded using an HP200 series computer on data disks. All data were transferred ashore to the IBM 3033 mainframe computer for editing and processing.

Station positions aboard ship were determined by LORAN C fixes and are claimed to be accurate to within about 0.1 km. A NAVOCEANO Neil Brown CTD and Sippican XBTs were used on the cruise. Their accuracies are stated in Table 1. The bottle surface salinity samples were determined ashore by a Guildline Model 8400 "Autosal" salinometer and its accuracy is stated in Table 1.

DATA PROCESSING

Data processing, such as estimating depth profiles for the XBT temperature profiles based on the descent speed, and conversion of CTD conductivity to salinity using the algorithm given in Lewis and Perkin (1981), was carried out on the IBM 3033 at the Naval Postgraduate School. The data were then edited by removing obvious salinity spikes and eliminating cast failures that were not identified during the cruise. Approximately 99% of casts were retained in the data sets. From a comparison of the CTD salinities with the salinity samples from the bottles, it was determined that the average salinity offset was +.016. Since this offset value was

small, no corrections were made to the salinities. The CTD data were interpolated to 5m intervals and then up and down casts were averaged.

The data have been transferred on digital tape to the National Oceanographic Data Center in Washington, DC.

DATA PRESENTATION

The cruise track, station locations (with XBTs and CTDs identified) and station numbers are shown in figures 2,3 and 4, respectively. On the cruise track figure, transect extremes are identified by letter to aid in cross-referencing the data presented in subsequent figures. These figures are followed by a listing of the stations, with their coordinates, the date and time when each station was occupied, and the surface information obtained at the station.

Vertical profiles of temperature from the XBT casts are shown in staggered fashion. The location of these profiles may be found by reference to the map of the cruise track. Transect extremes are identified as nearly as possible. The first profile on each plot is shown with its temperature unchanged; to each subsequent profile, an appropriate multiple of 5C has been added. Vertical profiles from the CTDs follow. Profiles of temperature are staggered by 5C and those of salinity by 4 ppt.

Isotherms for each transect are shown in the next pages. Based on instrument accuracy and the vertical temperature gradient, it is estimated that depths of isotherms in the main thermocline are uncertain to $\pm$20m. The tick marks identify station positions and, again, the transect extremes are shown on these plots.

Mean profiles of temperature from the XBTs, and temperature, salinity and sigma-t from the CTDs are given in figures 8 and 9, followed by a scatter diagram of the T-S pairs and the mean S(T) curve, with the $\pm$ standard deviation envelope. The data presentation concludes with a plot of the mean N^2 (Brunt-Vaisala frequency squared) profile, with $\pm$ the standard deviation. On the sigma-t and N^2 plots, the appropriate profiles derived from the mean temperature and mean salinity profiles are also shown.

Table 1: Scientific instruments aboard the USNS De STEIGUER

Instrument	Variable	Sensor	Accuracy	Resolution
Neil Brown CTD Mark IIIb	pressure temperature conductivity	strain gauge thermistor electrode cell	1.6 db 0.005 C 0.005 mmho	0.025 db 0.0005 C 0.001 mmh
Sippican XBT	temperature depth	thermistor descent speed	0.2 C greater of 4.6m and 2% of depth	
Internav LC 408 LORAN C	position	two chain LORAN receiver	100 meters	10 meters

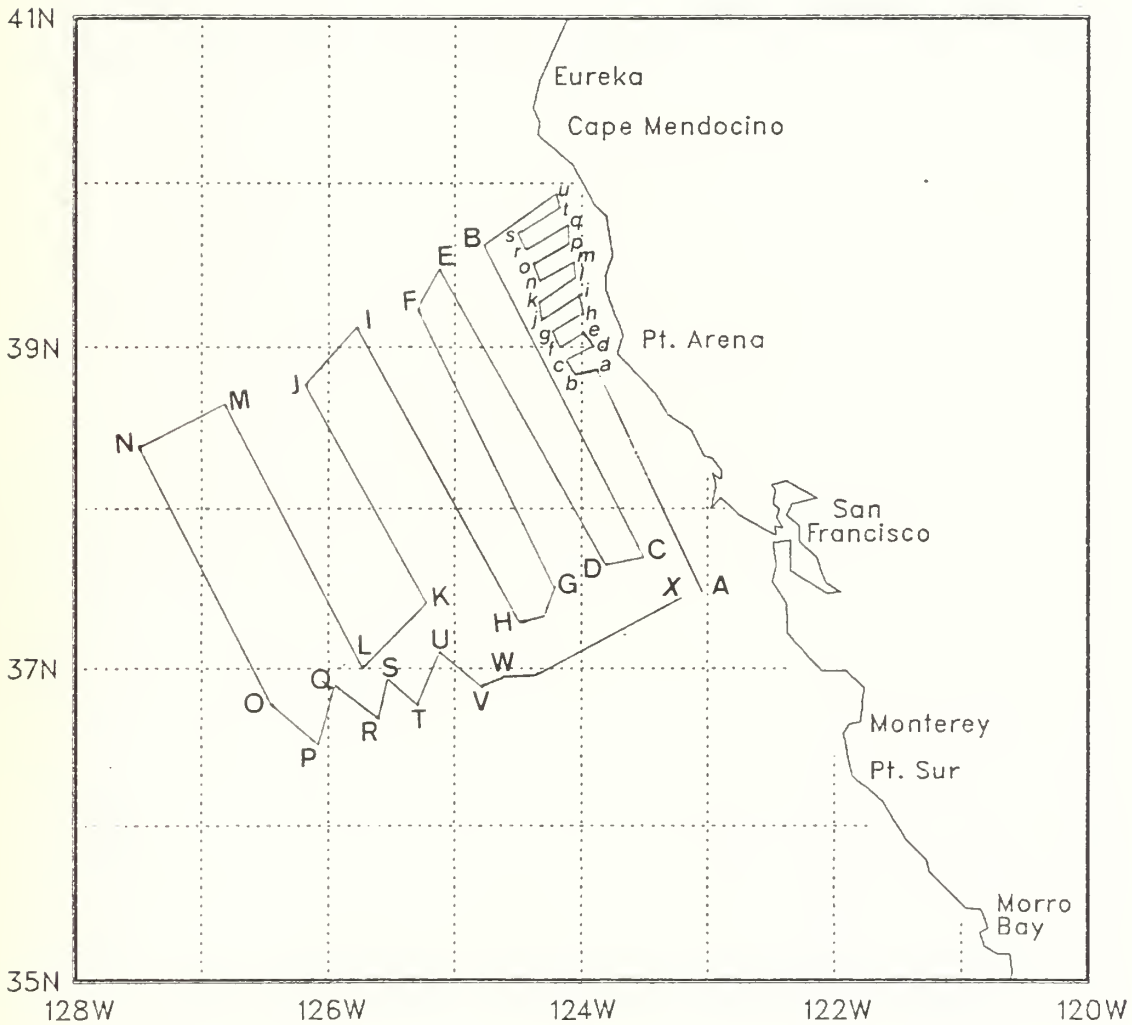


Figure 2: The cruise track for OPTOMA22.

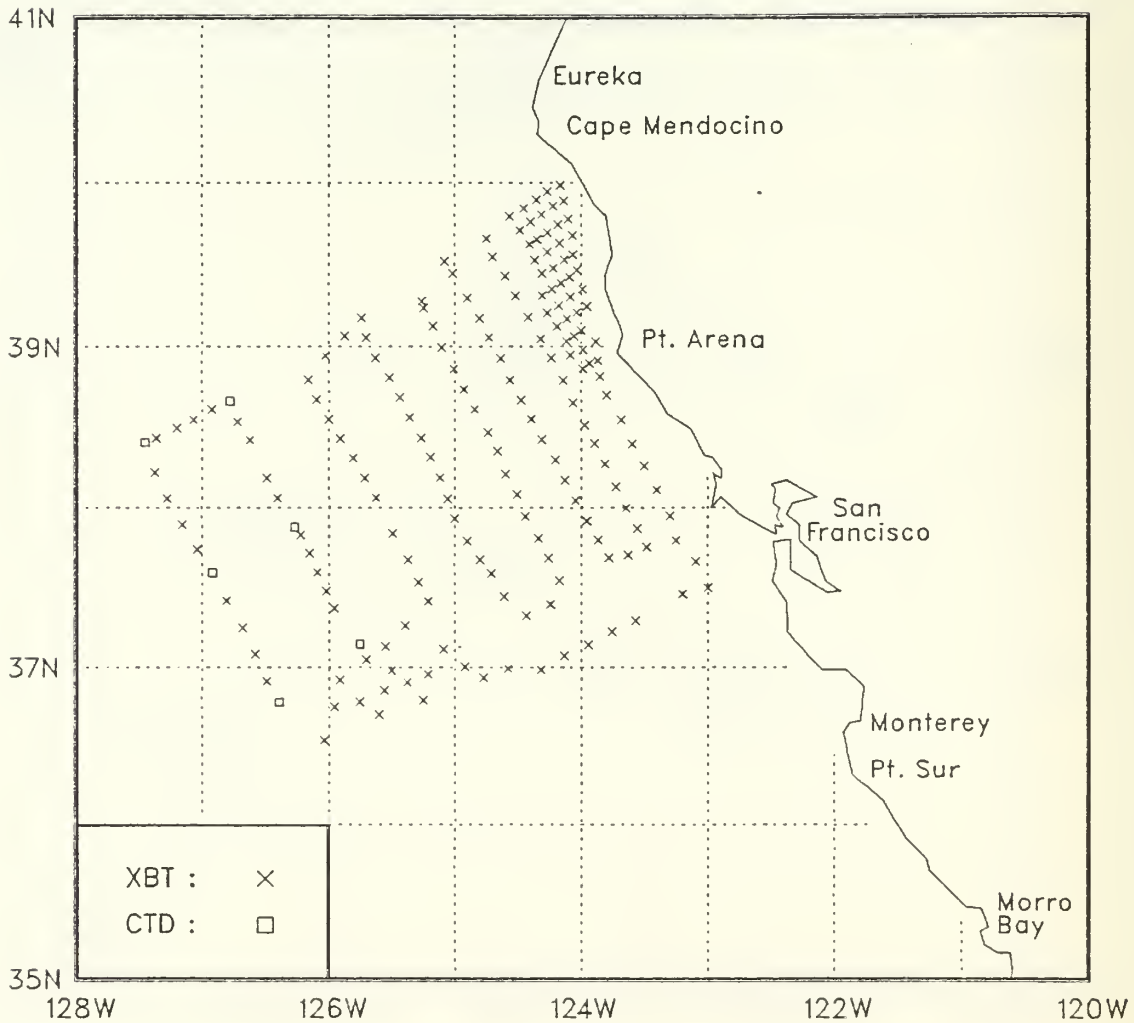


Figure 3: XBT and CTD locations for OPTOMA22.

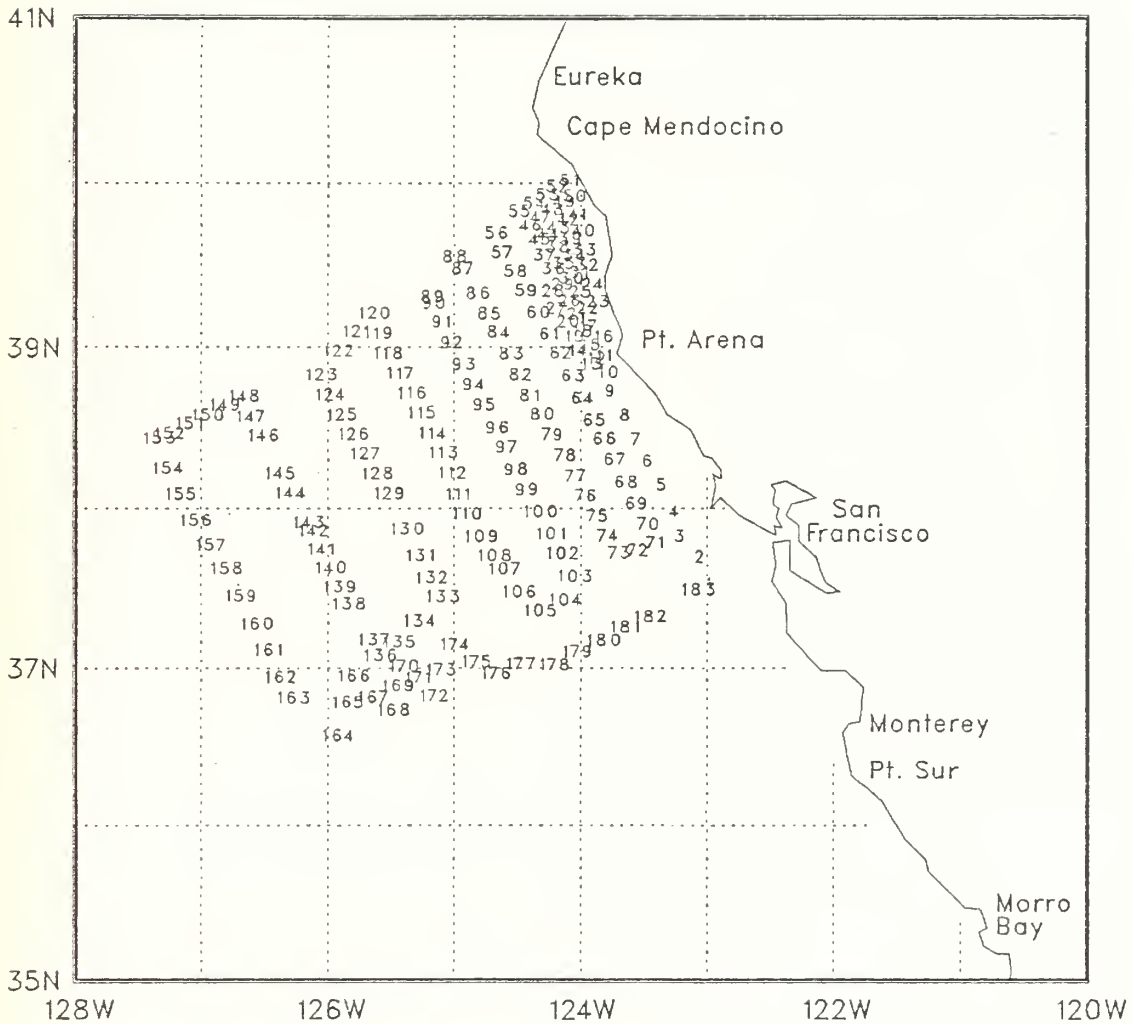


Figure 4: Station numbers for OPTOMA22.

Table 2: OPTOMA22 Station Listing

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
1	XBT	86209	741	37.30	123.00	13.4			
2	XBT	86209	859	37.40	123.06	12.8			
3	XBT	86209	955	37.48	123.15	12.4			
4	XBT	86209	1048	37.57	123.18	12.9			
5	XBT	86209	1143	38.07	123.24	11.4			
6	XBT	86209	1238	38.16	123.30	11.1			
7	XBT	86209	1330	38.24	123.36	11.0			
8	XBT	86209	1424	38.33	123.41	11.1			
9	XBT	86209	1517	38.42	123.48	11.3			
10	XBT	86209	1559	38.49	123.51	11.2			
11	XBT	86209	1629	38.55	123.52	11.2			
12	XBT	86209	1651	38.54	123.56	11.7			
13	XBT	86209	1709	38.52	123.59	12.3			
14	XBT	86209	1801	38.57	124.05	12.3			
15	XBT	86209	1824	38.59	123.59	11.9			
16	XBT	86209	1839	39.02	123.53	12.0			
17	XBT	86209	1946	39.06	124.00	12.2			
18	XBT	86209	2003	39.04	124.03	12.3			
19	XBT	86209	2022	39.02	124.07	12.2			
20	XBT	86209	2059	39.08	124.11	12.1			
21	XBT	86209	2121	39.10	124.06	11.9			
22	XBT	86209	2147	39.13	124.02	11.9			
23	XBT	86209	2206	39.15	123.57	11.7			
24	XBT	86209	2241	39.21	123.59	11.7			
25	XBT	86209	2314	39.18	124.05	12.6			
26	XBT	86209	2340	39.15	124.10	12.3			
27	XBT	86210	8	39.13	124.16	12.1			
28	XBT	86210	49	39.19	124.18	12.9			
29	XBT	86210	110	39.21	124.14	13.2			
30	XBT	86210	131	39.23	124.09	13.0			

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
31	XBT	86210	151	39.26	124.05	12.4			
32	XBT	86210	213	39.28	124.02	11.9			
33	XBT	86210	243	39.34	124.04	11.4			
34	XBT	86210	309	39.32	124.08	11.8			
35	XBT	86210	333	39.29	124.13	11.6			
36	XBT	86210	359	39.27	124.18	12.3			
37	XBT	86210	433	39.32	124.22	11.1			
38	XBT	86210	502	39.35	124.16	10.9			
39	XBT	86210	530	39.38	124.10	11.3			
40	XBT	86210	557	39.41	124.04	11.2			
41	XBT	86210	631	39.47	124.06	11.5			
42	XBT	86210	656	39.45	124.11	11.7			
43	XBT	86210	719	39.42	124.16	11.3			
44	XBT	86210	742	39.39	124.21	11.0			
45	XBT	86210	759	39.38	124.24	11.0			
46	XBT	86210	835	39.43	124.29	10.9			
47	XBT	86210	904	39.46	124.24	11.1			
48	XBT	86210	930	39.49	124.19	11.5			
49	XBT	86210	957	39.52	124.13	11.3			
50	XBT	86210	1022	39.54	124.08	11.3			
51	XBT	86210	1058	39.59	124.10	11.1			
52	XBT	86210	1129	39.57	124.16	11.6			
53	XBT	86210	1156	39.54	124.21	11.5			
54	XBT	86210	1223	39.51	124.27	11.5			
55	XBT	86210	1251	39.48	124.34	11.4			
56	XBT	86210	1359	39.40	124.45	11.2			
57	XBT	86210	1438	39.33	124.42	10.9			
58	XBT	86210	1523	39.26	124.36	12.0			
59	XBT	86210	1607	39.19	124.31	12.1			
60	XBT	86210	1651	39.11	124.25	12.1			
61	XBT	86210	1742	39.03	124.19	12.7			
62	XBT	86210	1825	38.56	124.14	13.4			

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
63	XBT	86210	1912	38.48	124.09	12.6			
64	XBT	86210	2000	38.39	124.04	12.5			
65	XBT	86210	2047	38.31	123.58	14.5			
66	XBT	86210	2130	38.24	123.53	12.6			
67	XBT	86210	2212	38.16	123.48	14.3			
68	XBT	86210	2302	38.08	123.43	14.5			
69	XBT	86210	2347	38.00	123.39	14.5			
70	XBT	86211	35	37.52	123.33	14.2			
71	XBT	86211	114	37.45	123.29	14.4			
72	XBT	86211	156	37.42	123.38	14.3			
73	XBT	86211	242	37.42	123.47	14.0			
74	XBT	86211	324	37.48	123.52	14.4			
75	XBT	86211	414	37.55	123.57	15.0			
76	XBT	86211	502	38.03	124.03	13.5			
77	XBT	86211	604	38.10	124.07	14.7			
78	XBT	86211	722	38.18	124.12	14.4			
79	XBT	86211	840	38.26	124.18	12.9			
80	XBT	86211	1008	38.33	124.23	14.3			
81	XBT	86211	1132	38.40	124.28	13.6			
82	XBT	86211	1258	38.48	124.33	13.6			
83	XBT	86211	1432	38.56	124.38	13.2			
84	XBT	86211	1605	39.04	124.44	13.0			
85	XBT	86211	1732	39.11	124.48	13.1			
86	XBT	86211	1904	39.18	124.54	12.5			
87	XBT	86211	2047	39.27	125.01	12.7			
88	XBT	86211	2156	39.31	125.05	12.8			
89	XBT	86211	2333	39.17	125.15	12.4			
90	XBT	86211	2349	39.14	125.15	13.1			
91	XBT	86212	29	39.07	125.10	13.3			
92	XBT	86212	111	39.00	125.06	13.1			
93	XBT	86212	159	38.52	125.01	13.3			
94	XBT	86212	244	38.44	124.56	13.2			

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
95	XBT	86212	327	38.37	124.51	12.8			
96	XBT	86212	413	38.28	124.45	13.3			
97	XBT	86212	455	38.21	124.40	13.2			
98	XBT	86212	537	38.13	124.36	12.8			
99	XBT	86212	618	38.05	124.31	14.3			
100	XBT	86212	702	37.57	124.26	13.5			
101	XBT	86212	751	37.49	124.20	13.4			
102	XBT	86212	830	37.41	124.16	14.8			
103	XBT	86212	919	37.33	124.10	14.8			
104	XBT	86212	1008	37.24	124.14	15.1			
105	XBT	86212	1207	37.20	124.26	15.0			
106	XBT	86212	1346	37.27	124.36	14.0			
107	XBT	86212	1537	37.35	124.43	13.7			
108	XBT	86212	1644	37.40	124.48	13.9			
109	XBT	86212	1815	37.48	124.54	13.6			
110	XBT	86212	1956	37.56	125.00	15.4			
111	XBT	86212	2119	38.03	125.03	15.1			
112	XBT	86212	2245	38.11	125.07	13.6			
113	XBT	86213	9	38.19	125.11	15.2			
114	XBT	86213	135	38.26	125.16	15.6			
115	XBT	86213	308	38.34	125.21	15.4			
116	XBT	86213	437	38.41	125.26	13.2			
117	XBT	86213	619	38.49	125.31	13.2			
118	XBT	86213	825	38.56	125.38	13.4			
119	XBT	86213	1028	39.03	125.42	12.5			
120	XBT	86213	1214	39.11	125.45	12.4			
121	XBT	86213	1258	39.04	125.52	12.5			
122	XBT	86213	1352	38.57	126.01	13.3			
123	XBT	86213	1428	38.48	126.10	14.2			
124	XBT	86213	1517	38.41	126.05	15.7			
125	XBT	86213	1602	38.33	126.00	13.4			
126	XBT	86213	1646	38.26	125.54	13.4			

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
127	XBT	86213	1731	38.19	125.49	13.8			
128	XBT	86213	1816	38.11	125.43	13.5			
129	XBT	86213	1902	38.04	125.38	14.1			
130	XBT	86213	1950	37.51	125.30	14.5			
131	XBT	86213	2046	37.41	125.22	14.8			
132	XBT	86213	2130	37.32	125.18	16.3			
133	XBT	86213	2209	37.25	125.13	15.4			
134	XBT	86213	2317	37.16	125.24	15.9			
135	XBT	86214	5	37.08	125.33	16.1			
136	XBT	86214	55	37.03	125.42	16.0			
137	CTD	86214	223	37.09	125.45	15.5	32.71	*	32.77
138	XBT	86214	625	37.22	125.57	16.0			
139	XBT	86214	741	37.29	126.02	16.0			
140	XBT	86214	906	37.36	126.05	17.1			
141	XBT	86214	1034	37.43	126.09	16.2			
142	XBT	86214	1318	37.50	126.13	15.6			
143	CTD	86214	1543	37.53	126.16	15.8	32.72	15.9	32.74
144	XBT	86214	1809	38.04	126.24	16.3			
145	XBT	86214	1925	38.11	126.29	16.2			
146	XBT	86214	2206	38.25	126.37	16.5			
147	XBT	86214	2332	38.32	126.43	16.5			
148	CTD	86215	138	38.40	126.47	16.3	32.71	16.4	32.78
149	XBT	86215	311	38.37	126.56	16.4			
150	XBT	86215	412	38.33	127.04	16.5			
151	XBT	86215	515	38.30	127.12	16.7			
152	XBT	86215	619	38.26	127.22	16.5			
153	CTD	86215	742	38.25	127.27	16.1	32.78	16.1	32.78
154	XBT	86215	946	38.13	127.23	16.9			
155	XBT	86215	1110	38.04	127.17	16.7			
156	XBT	86215	1229	37.54	127.10	16.5			
157	XBT	86215	1353	37.45	127.02	16.4			
158	CTD	86215	1545	37.36	126.55	15.9	32.76	16.1	32.78

STN	TYPE	YR/DAY	GMT	LAT (NORTH) (DD.MM)	LONG (WEST) (DDD.MM)	SURFACE TEMP (DEG C)	SURFACE SALINITY (PPT)	BUCKET TEMP (DEG C)	BOTTLE SALINITY (PPT)
159	XBT	86215	1731	37.25	126.48	17.1			
160	XBT	86215	1831	37.15	126.41	17.0			
161	XBT	86215	1929	37.05	126.35	17.1			
162	XBT	86215	2023	36.55	126.29	17.2			
163	CTD	86215	2201	36.47	126.23	16.8	32.84	17.0	*
164	XBT	86216	144	36.32	126.02	16.0			
165	XBT	86216	404	36.45	125.57	16.0			
166	XBT	86216	602	36.55	125.55	16.1			
167	XBT	86216	711	36.47	125.45	15.7			
168	XBT	86216	811	36.42	125.36	14.8			
169	XBT	86216	1110	36.51	125.34	15.1			
170	XBT	86216	1410	36.59	125.30	14.8			
171	XBT	86216	1455	36.54	125.23	13.5			
172	XBT	86216	1546	36.47	125.16	14.2			
173	XBT	86216	1751	36.57	125.13	13.7			
174	XBT	86216	2051	37.07	125.06	14.1			
175	XBT	86216	2143	37.00	124.56	14.7			
176	XBT	86216	2233	36.56	124.46	14.9			
177	XBT	86216	2331	37.00	124.35	15.0			
178	XBT	86217	114	36.59	124.19	15.2			
179	XBT	86217	217	37.04	124.08	15.1			
180	XBT	86217	317	37.08	123.56	15.1			
181	XBT	86217	431	37.14	123.45	13.6			
182	XBT	86217	543	37.18	123.34	14.7			
183	XBT	86217	837	37.28	123.12	15.4			

* Data not available

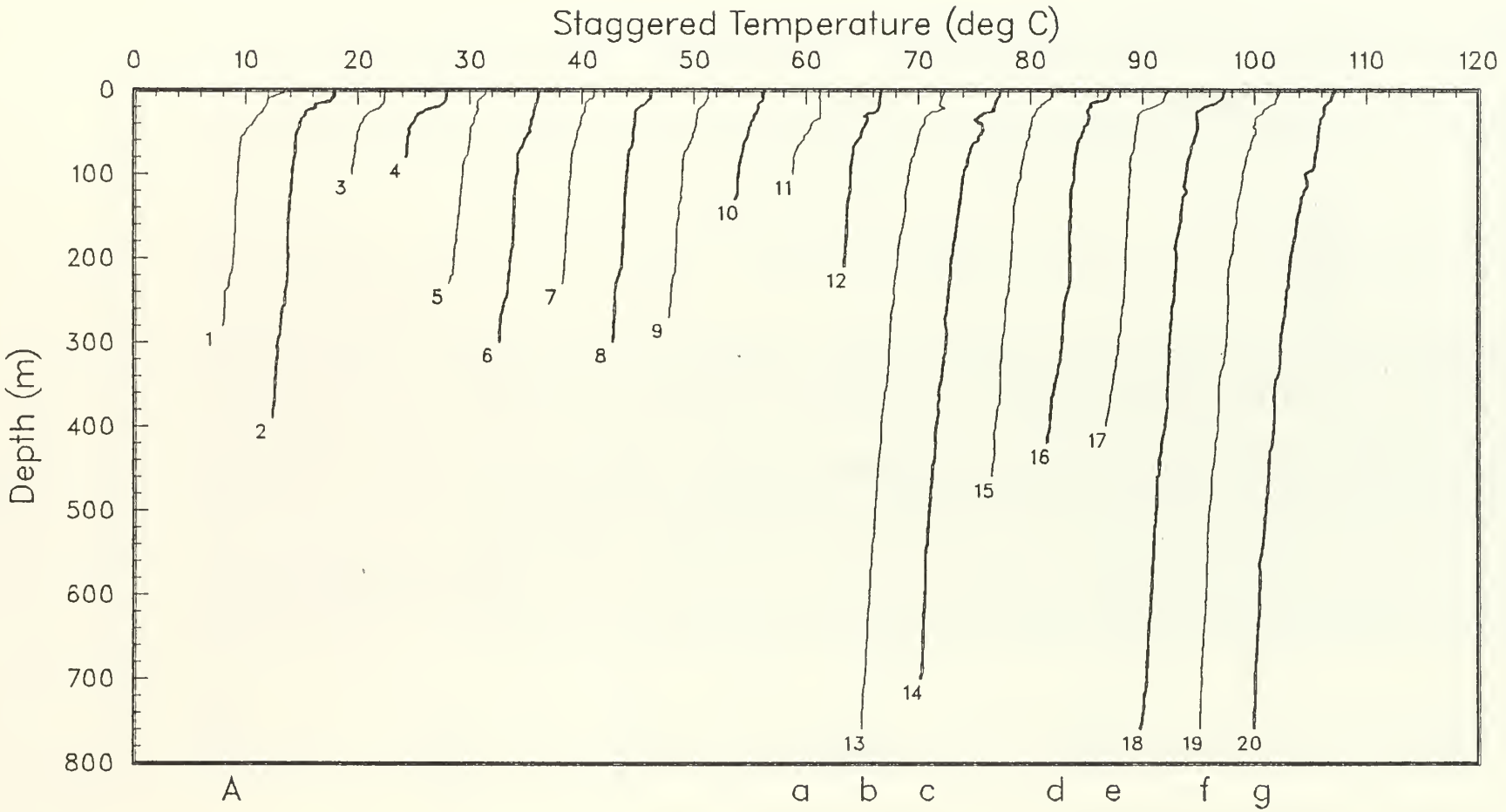
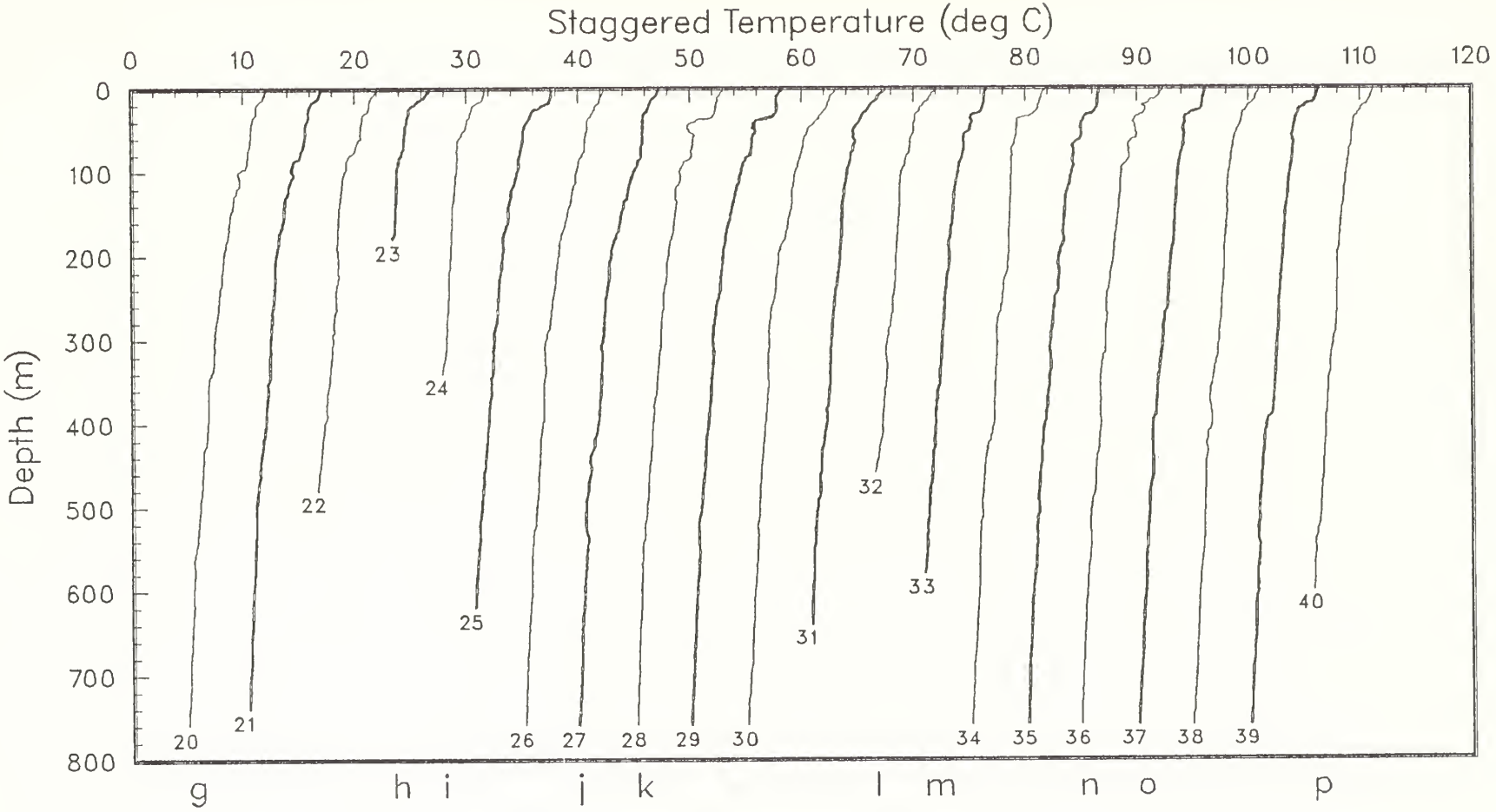


Figure 5(a): XBT temperature profiles, staggered by multiples of 5C (OPTOMA22).


Staggered Temperature (deg C)
0
10
20
30
40
50
60
70
80
90
100
110
120
Depth (m)
0
100
200
300
400
500
600
700
800
20
21
22
23
24
25
26
27
28
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30
31
32
33
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39
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g
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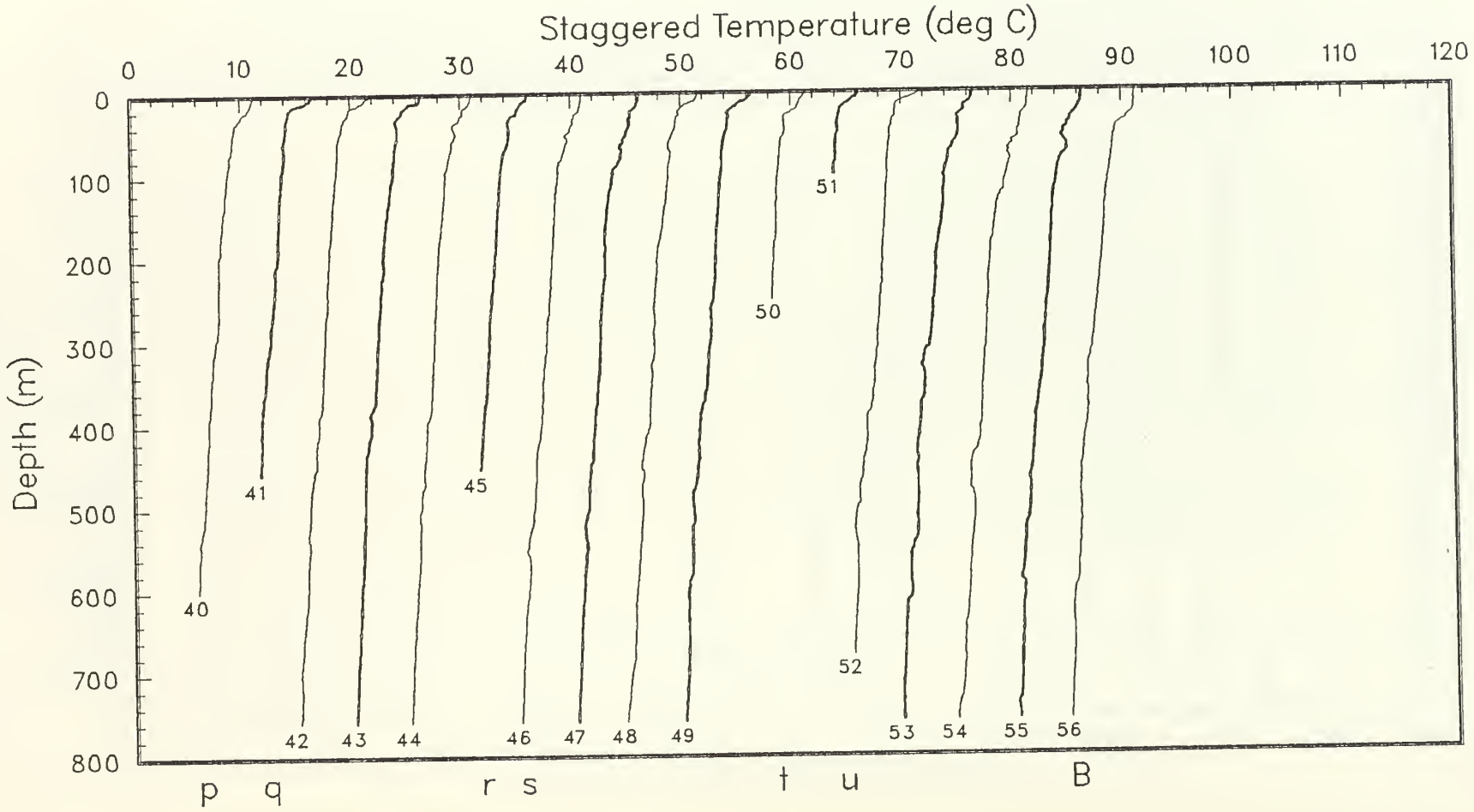
p

Figure 5(b)


Staggered Temperature (deg C)
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Depth (m)
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200
300
400
500
600
700
800
40
41
42
43
44
45
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52
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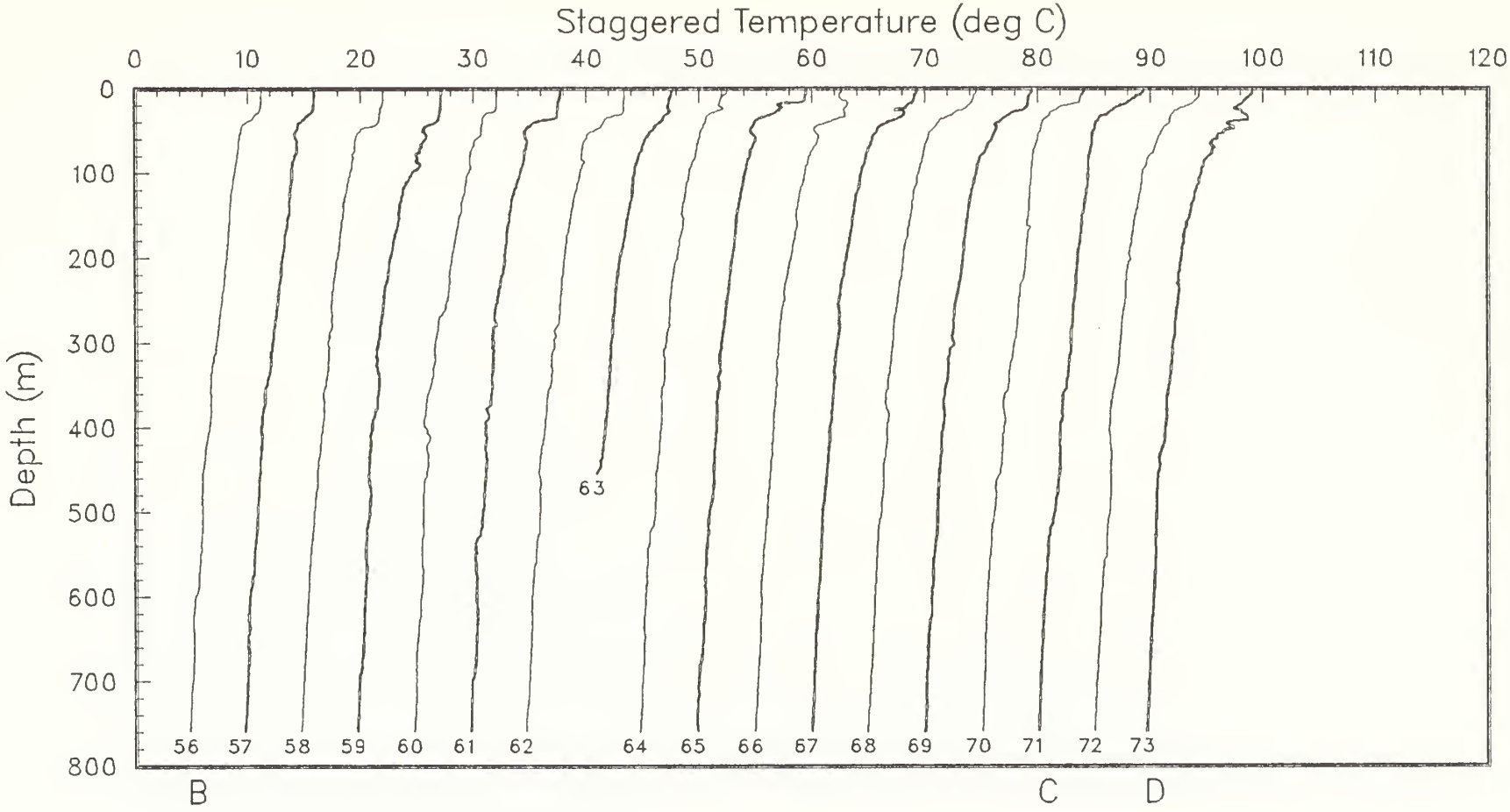
56
p
q
r
s
t
u
B

Figure 5(c)


Staggered Temperature (deg C)
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Depth (m)
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300
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500
600
700
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56
57
58
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68
69
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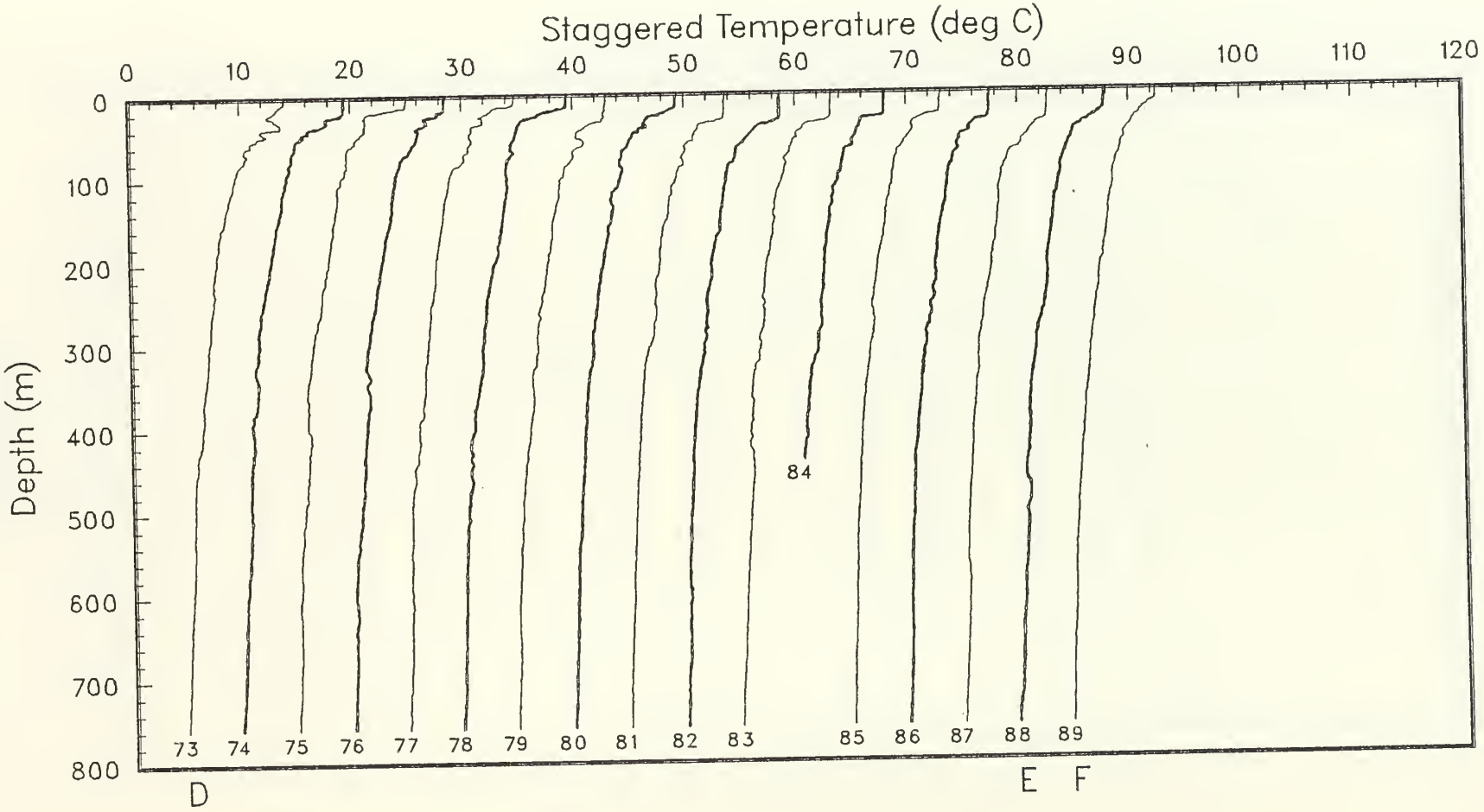
71
72
73
B
C
D

Figure 5(d)


Staggered Temperature (deg C)
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Depth (m)
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600
700
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73
74
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83
84
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86
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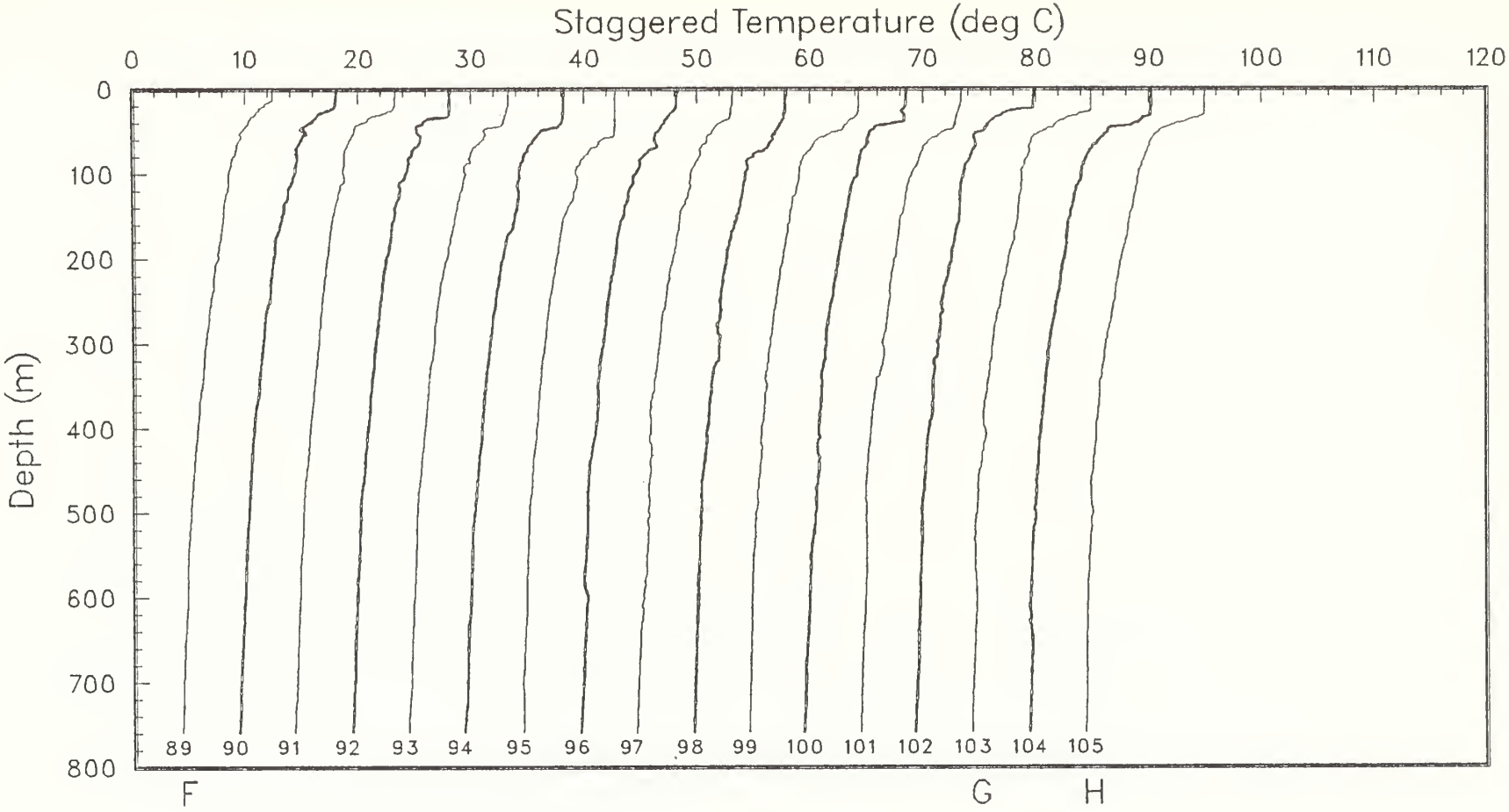
88
89
D
E
F

Figure 5(e)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Depth (m)
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89
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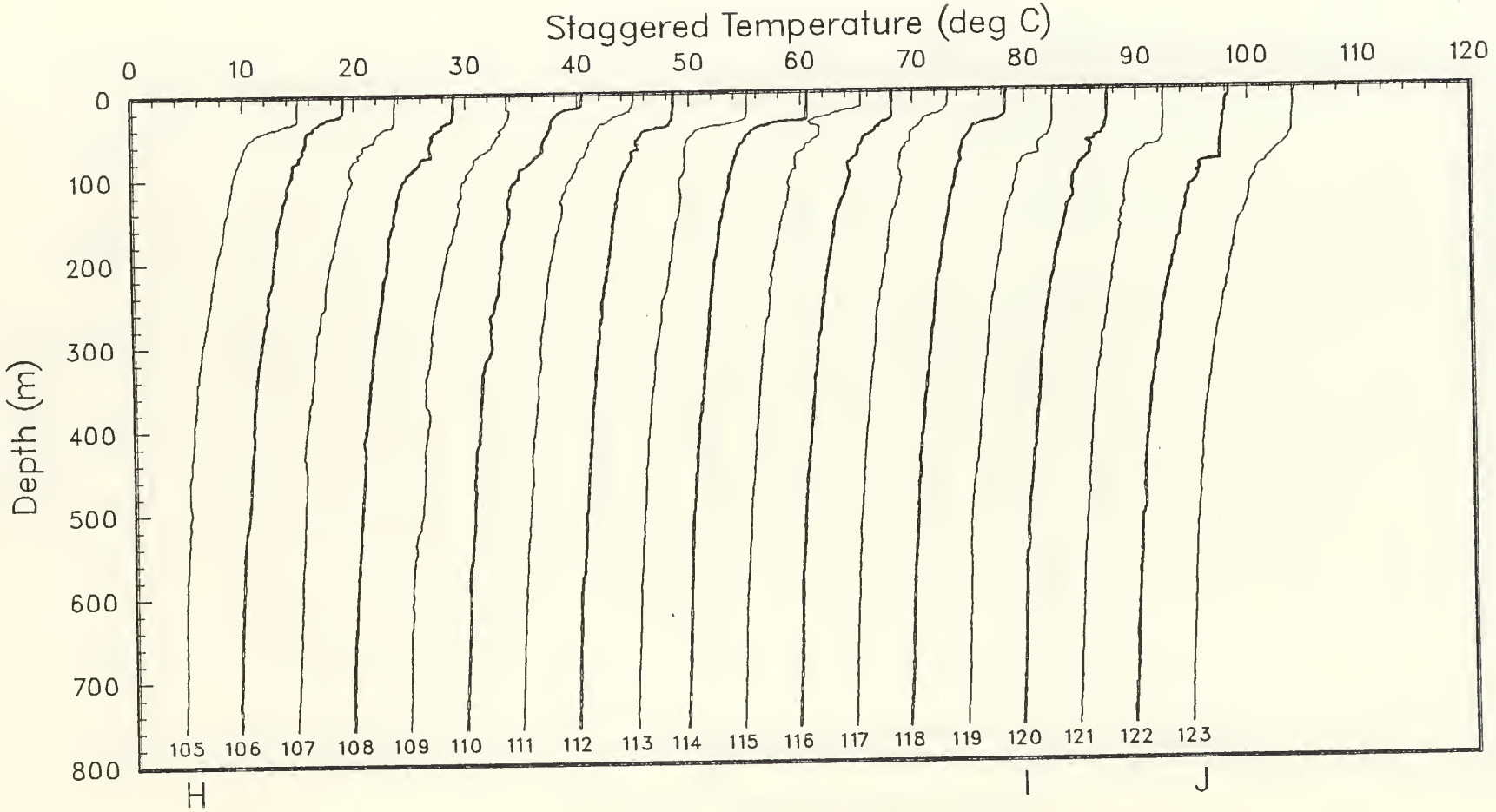
102
103
104
105
F
G
H

Figure 5(f)


Staggered Temperature (deg C)
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Depth (m)
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700
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106
107
108
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115
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117
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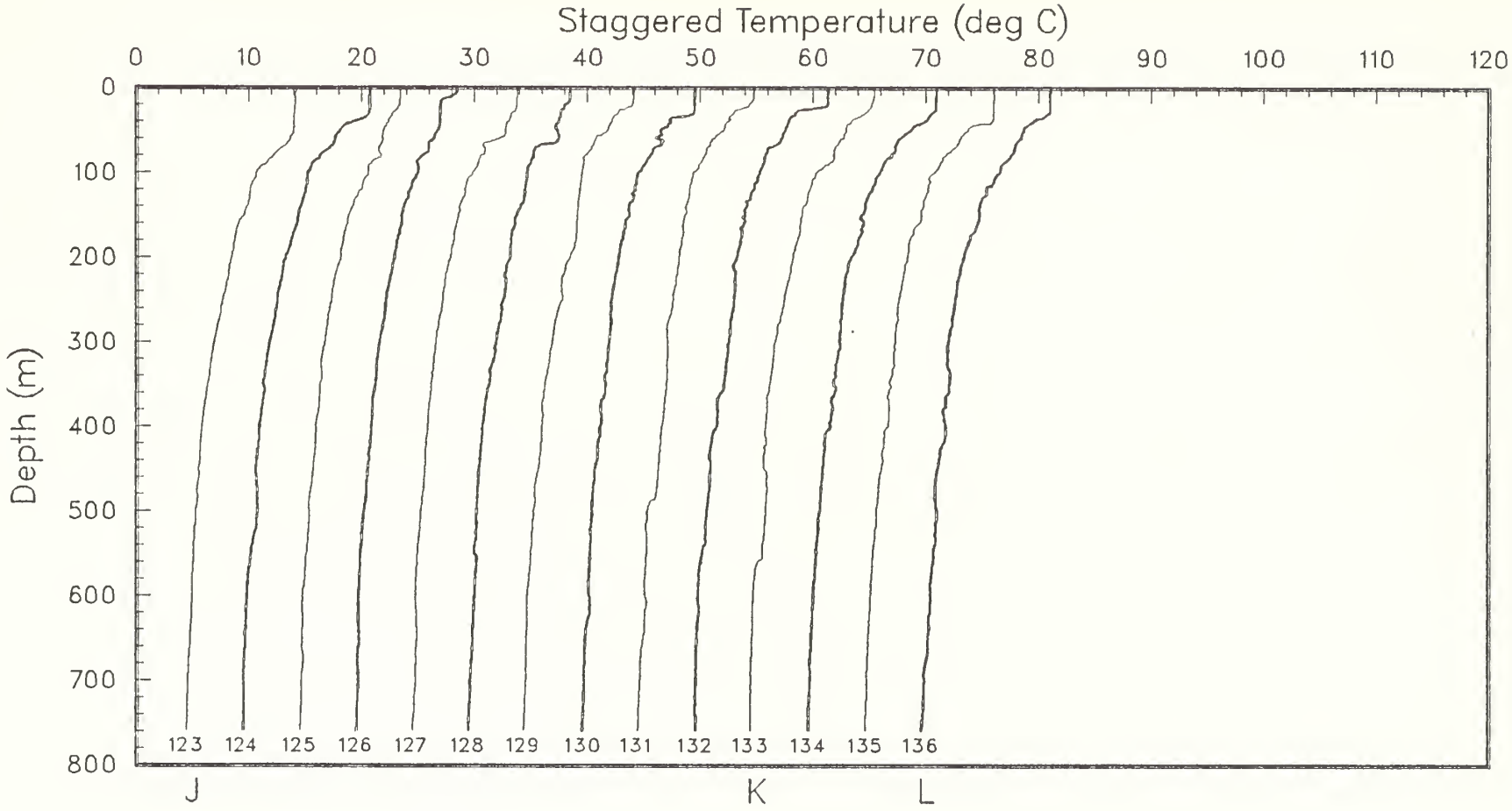
120
121
122
123
H
I
J

Figure 5(g)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Depth (m)
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400
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700
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128
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130
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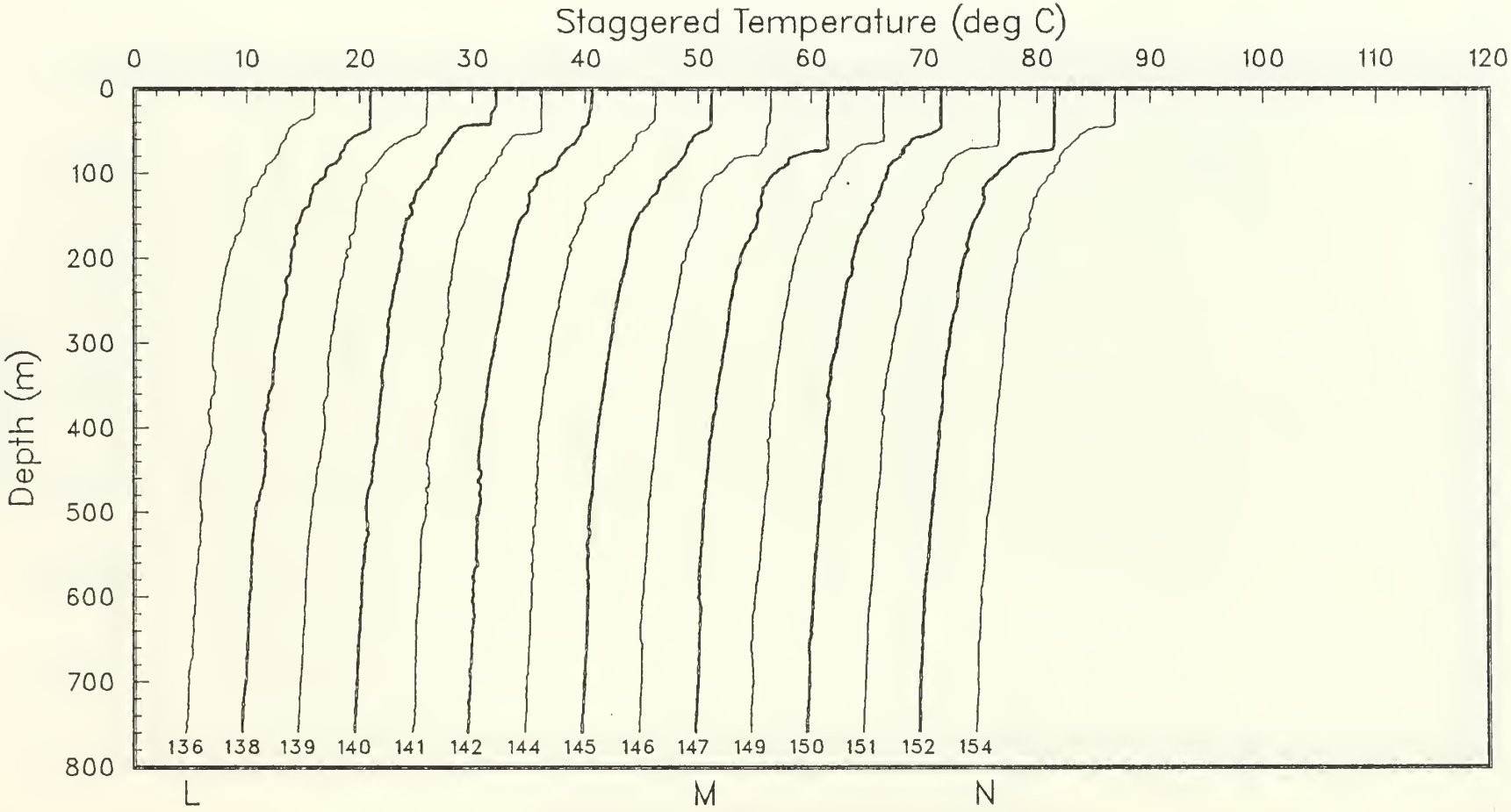
132
133
134
135
136
J
K
L

Figure 5(h)


Staggered Temperature (deg C)
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Depth (m)
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300
400
500
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700
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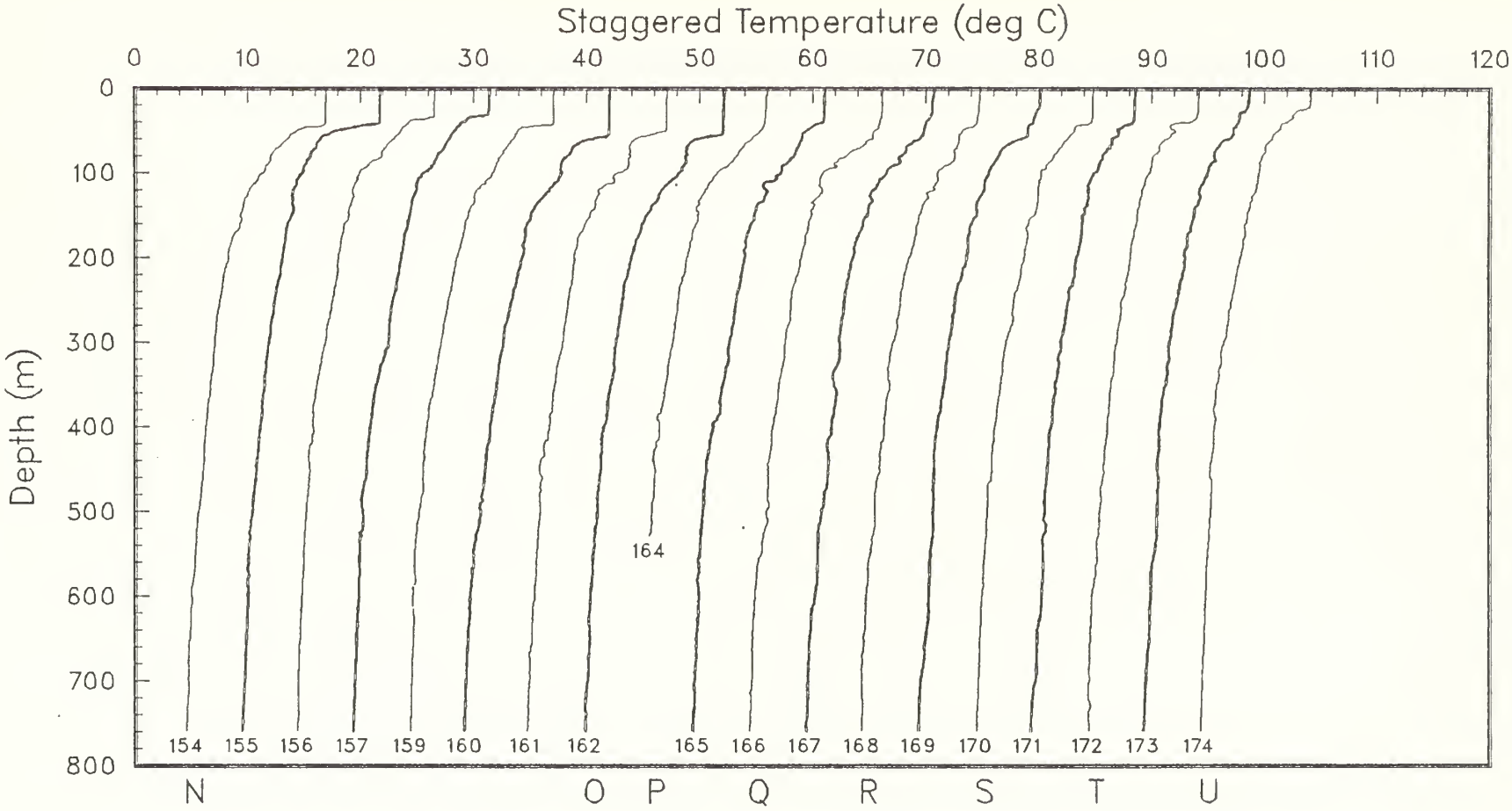
151
152
154
L
M
N

Figure 5(i)


Staggered Temperature (deg C)
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30
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80
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100
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120
Depth (m)
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100
200
300
400
500
600
700
800
154
155
156
157
159
160
161
162
164
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166
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174
N
O
P
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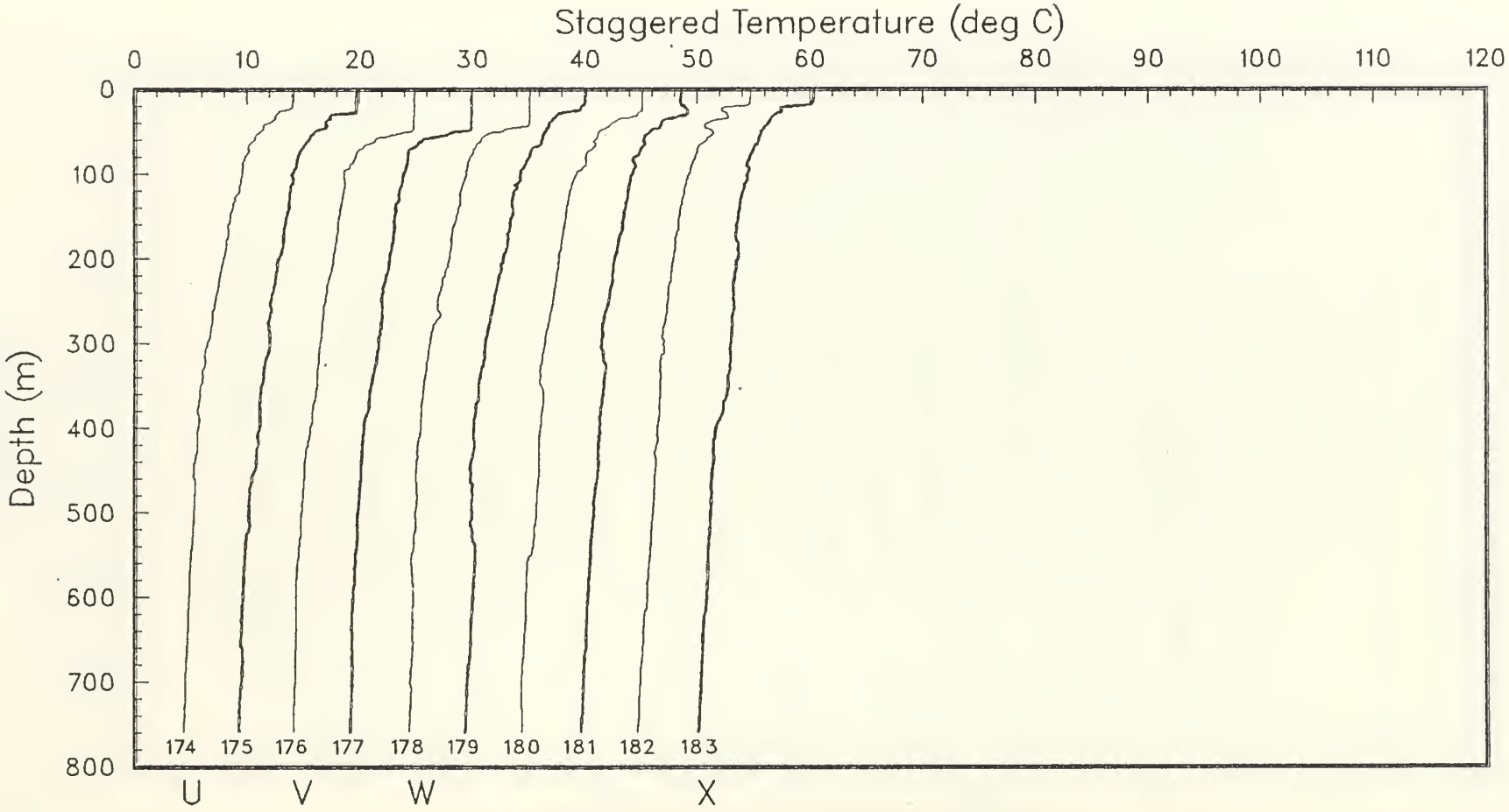
S
T
U

Figure 5(j)


Staggered Temperature (deg C)
0
10
20
30
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60
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80
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120
Depth (m)
0
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200
300
400
500
600
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174
175
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181
182
183
U
V
W
X

Figure 5(k)

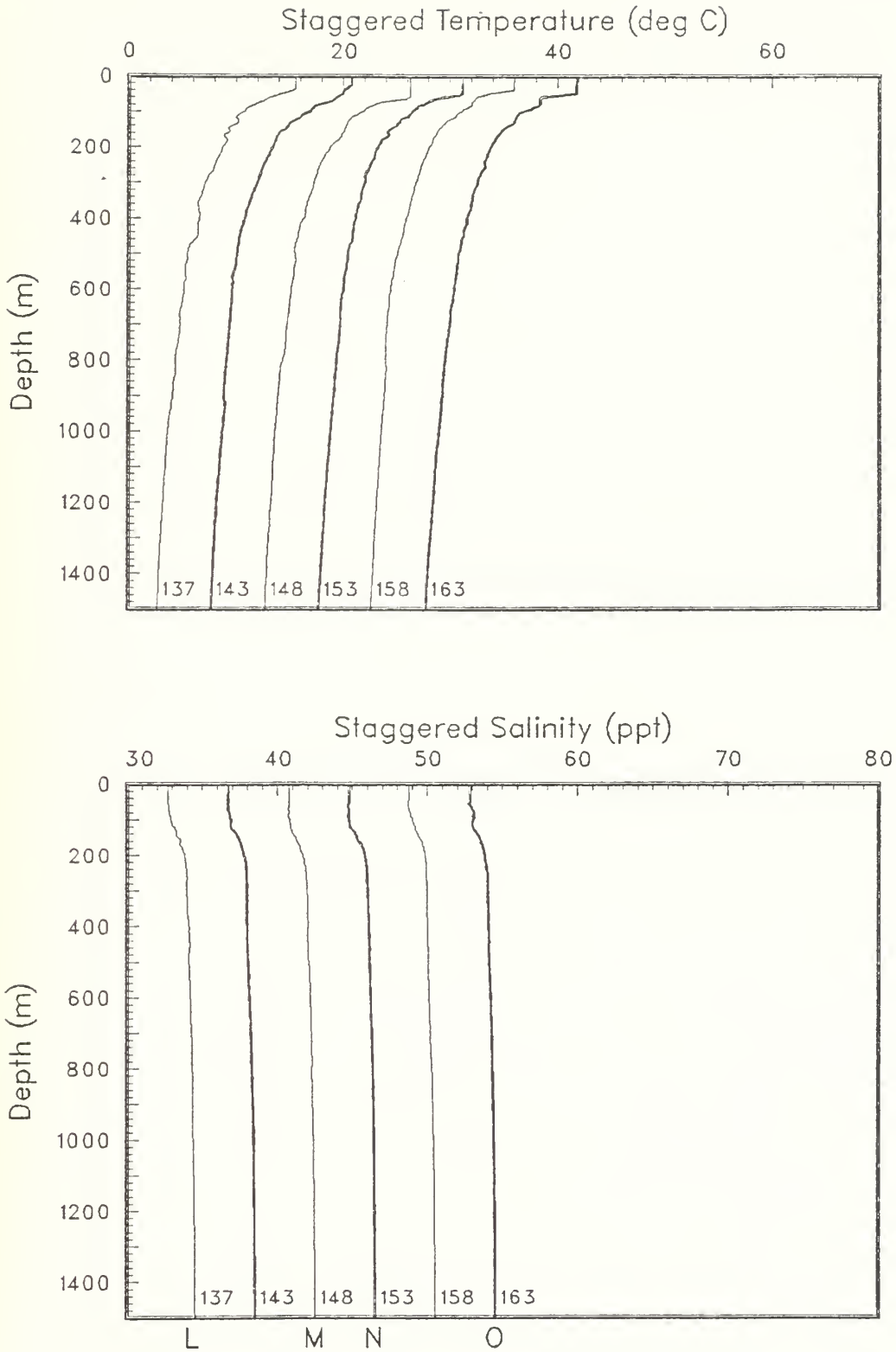
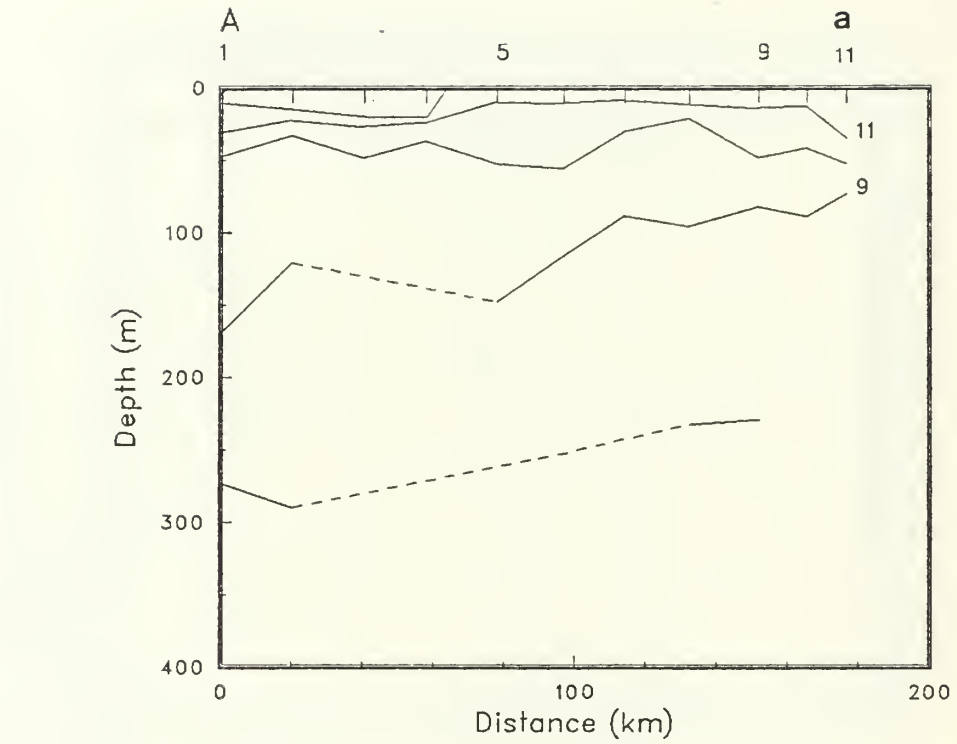


Figure 6: CTD temperature profiles, staggered by multiples of 5C, and salinity profiles staggered by multiples of 4 ppt to 1500m (OPTOMA22).



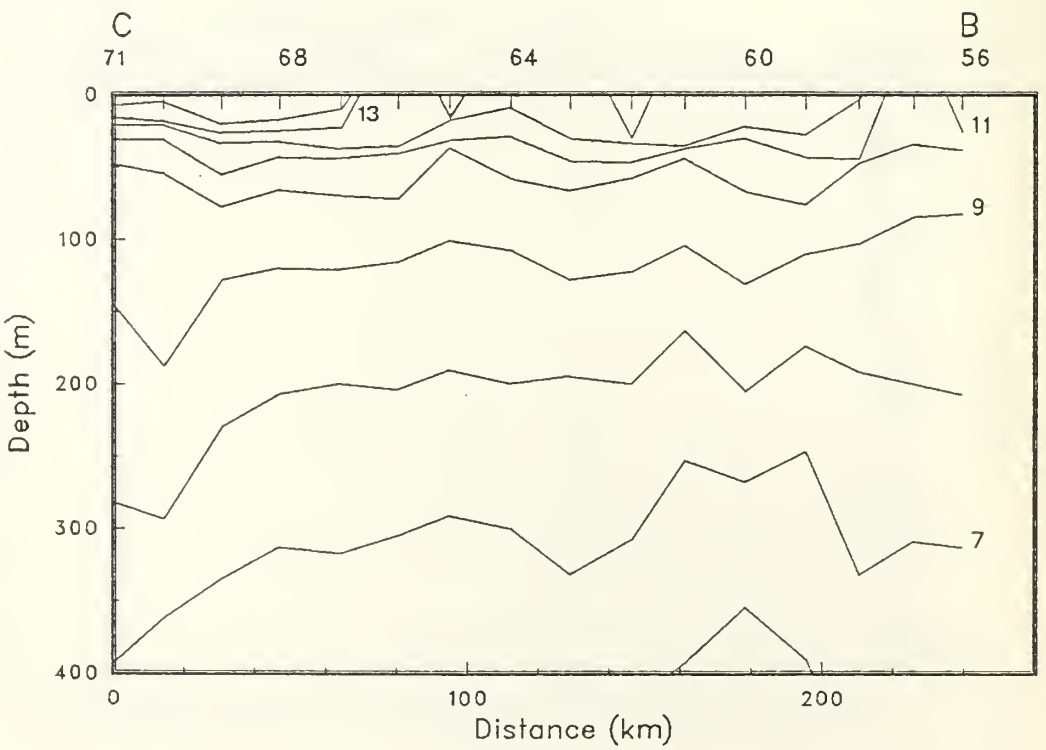


Figure 7(a)-(b): Along-track isotherms. Tick marks along the upper horizontal axis show station positions. Some station numbers are given. Dashed lines are used if the cast was too shallow (OPTOMA22).

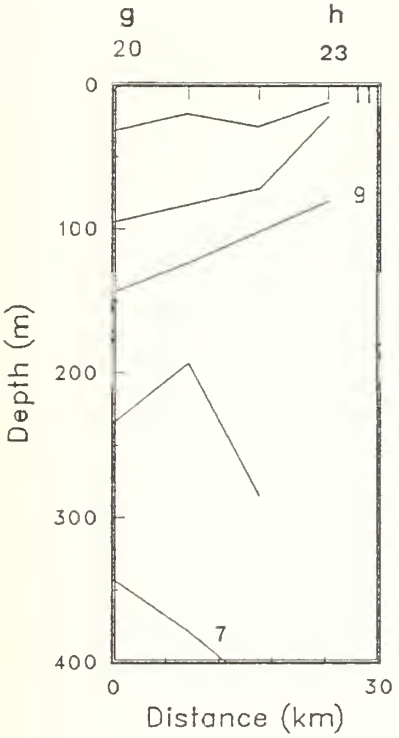


Figure 7(c)

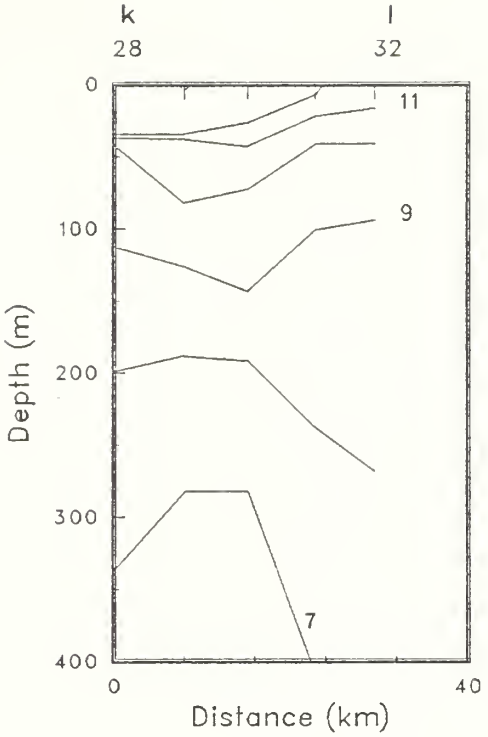
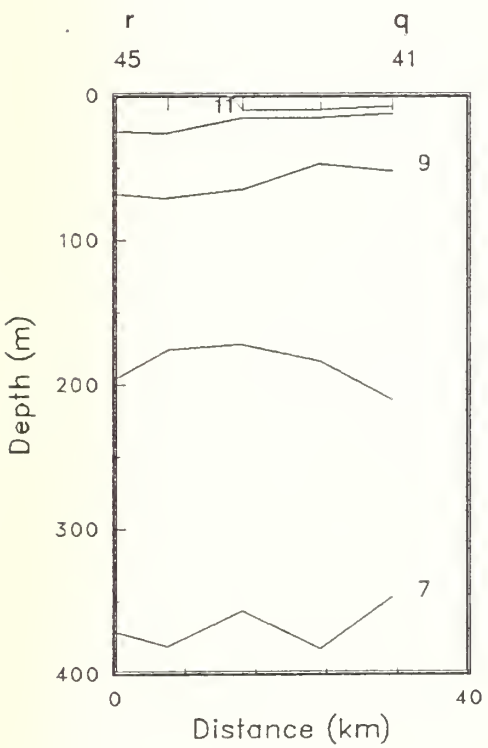


Figure 7(d)



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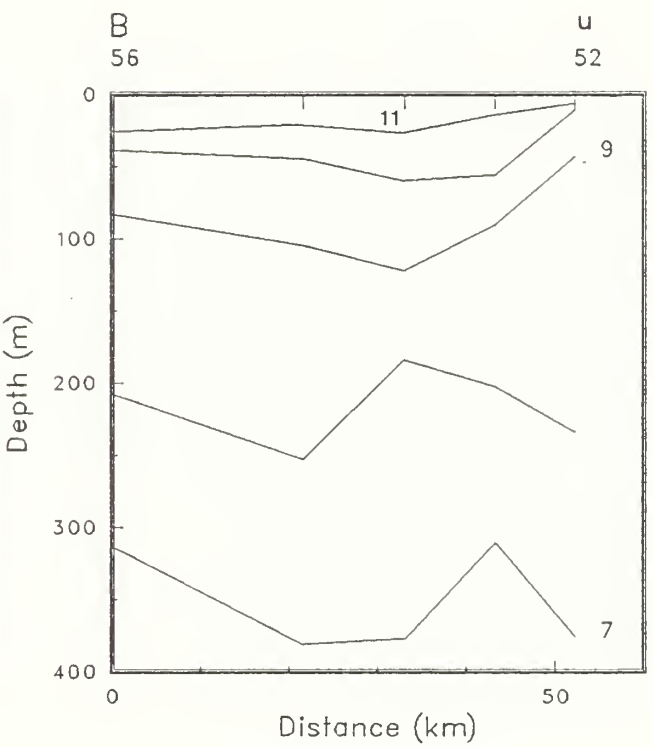

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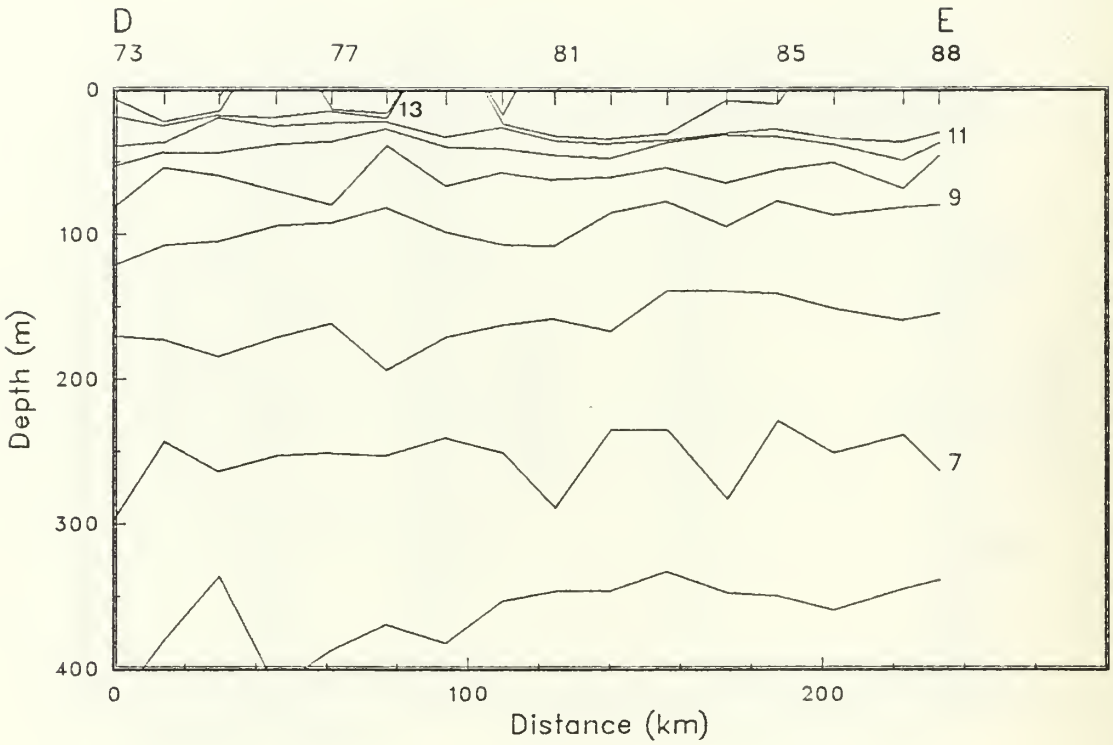

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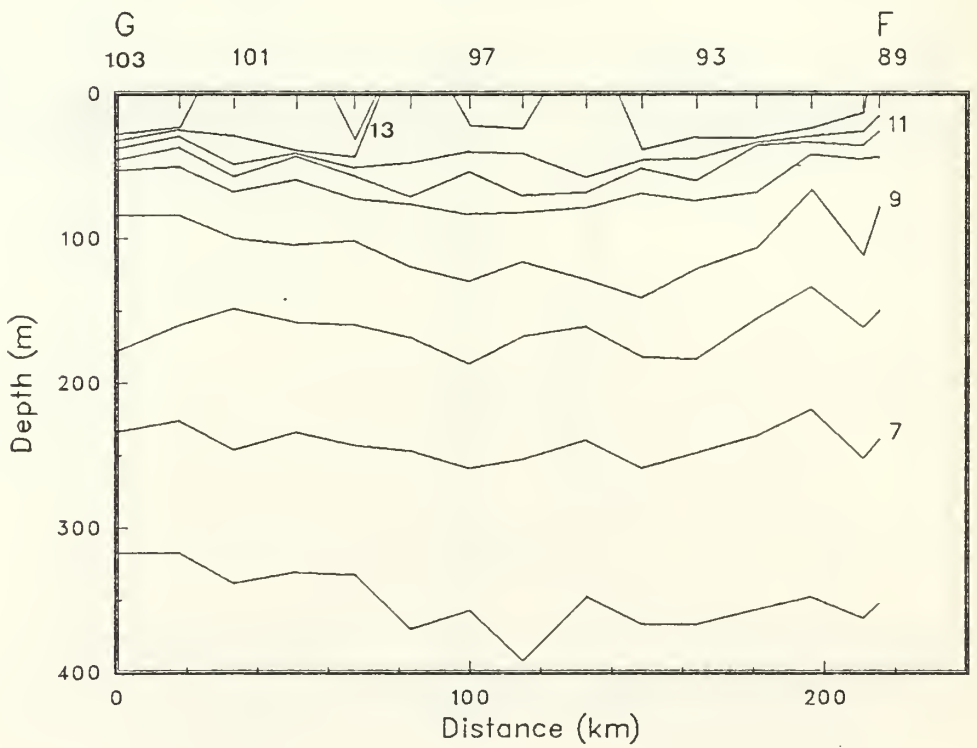

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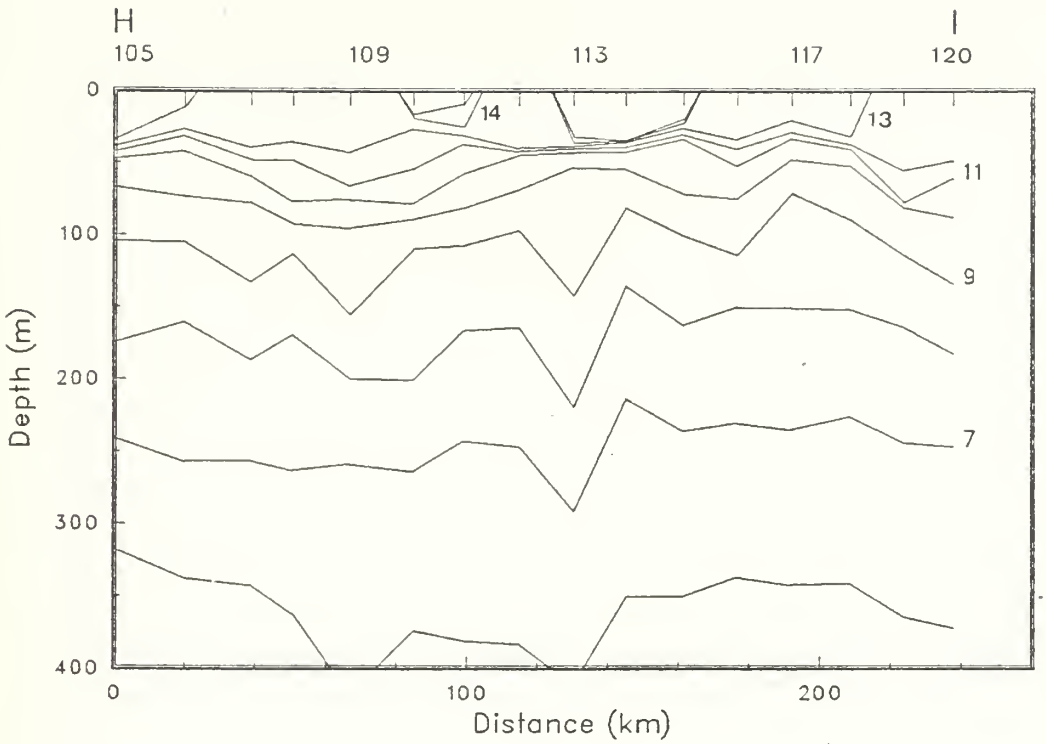

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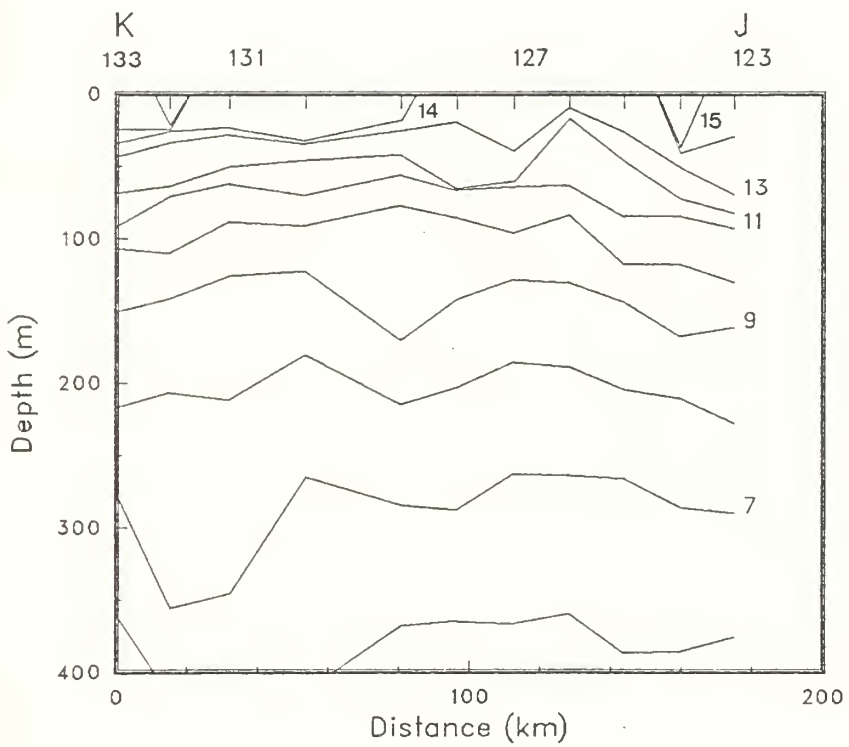
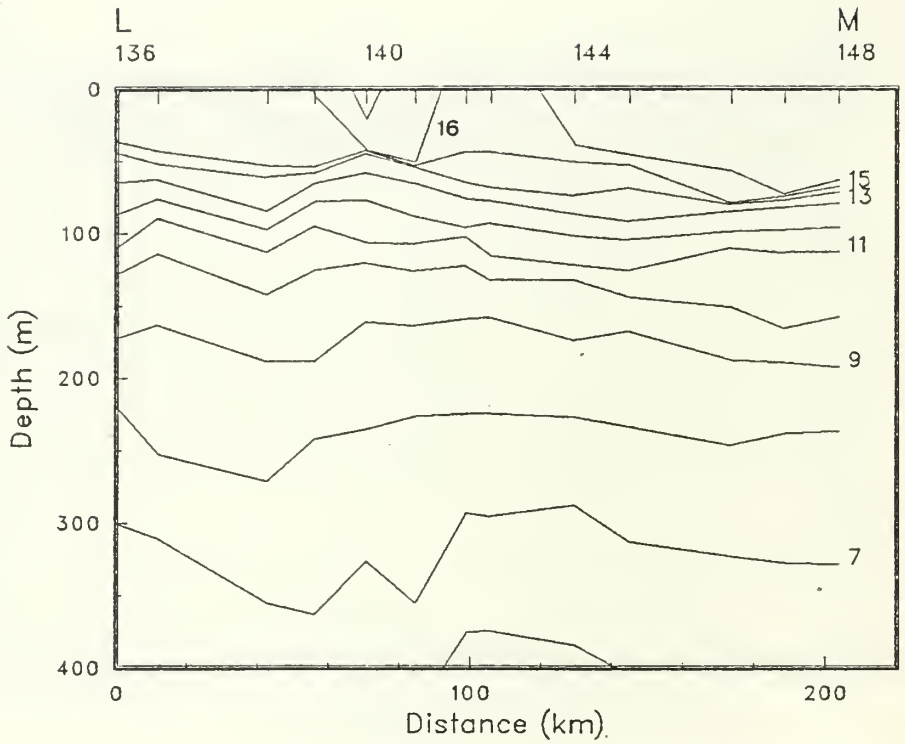


Figure 7(j)



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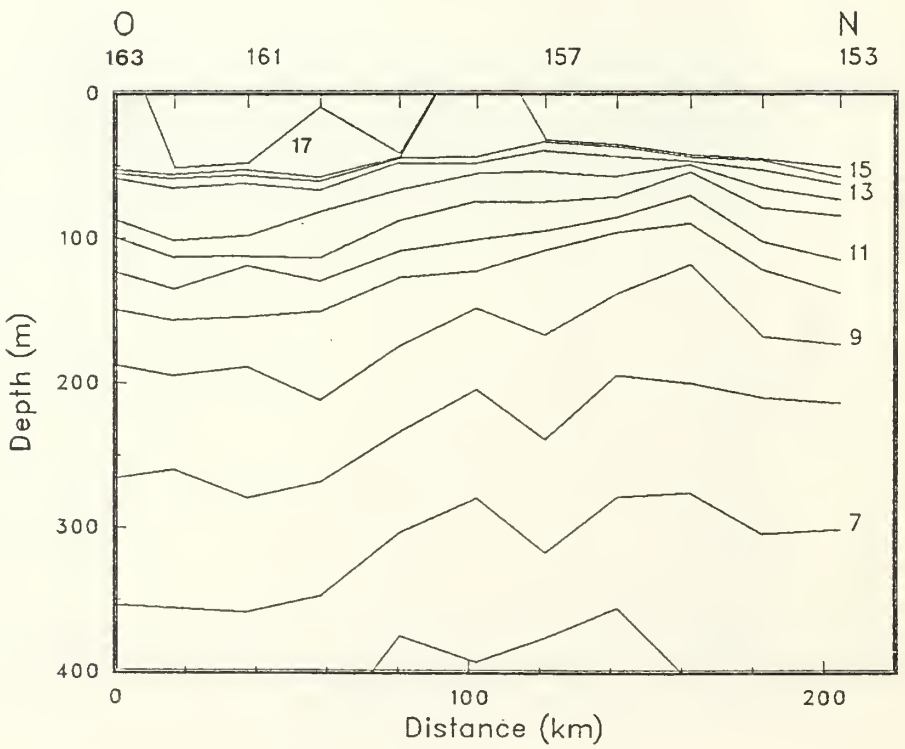
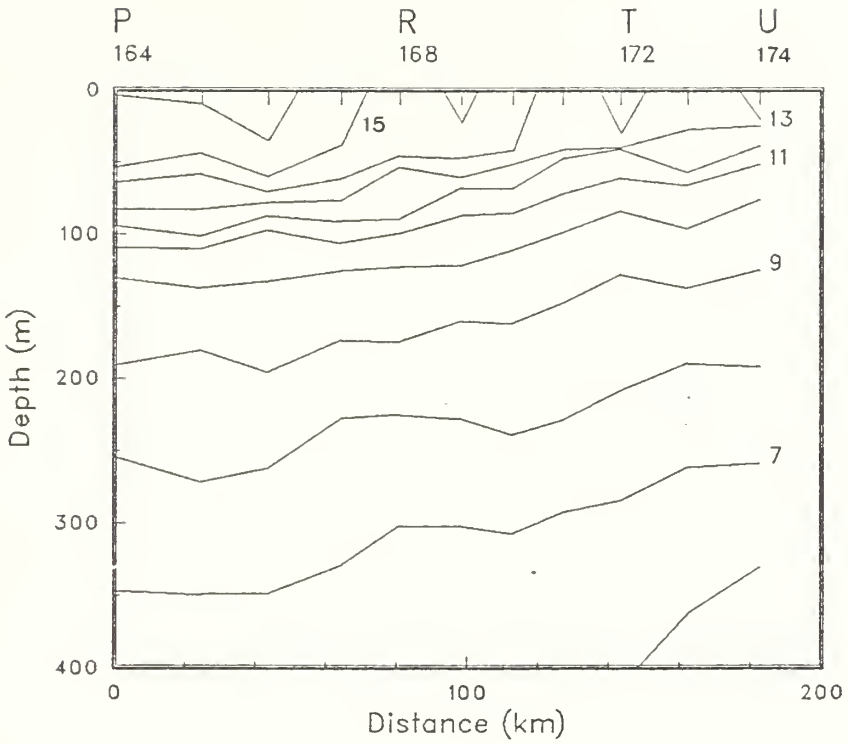


Figure 7(l)



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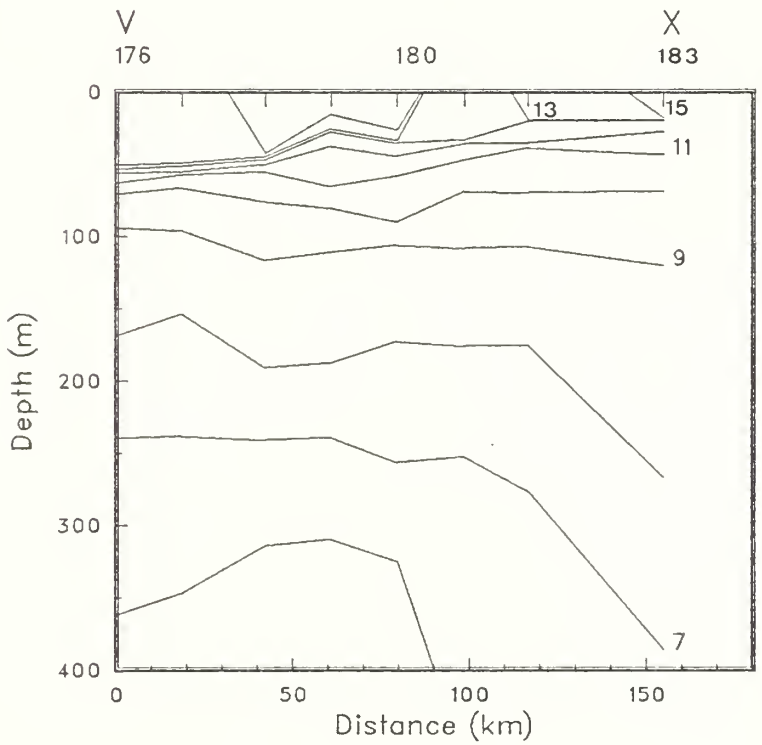

Figure 7(n)

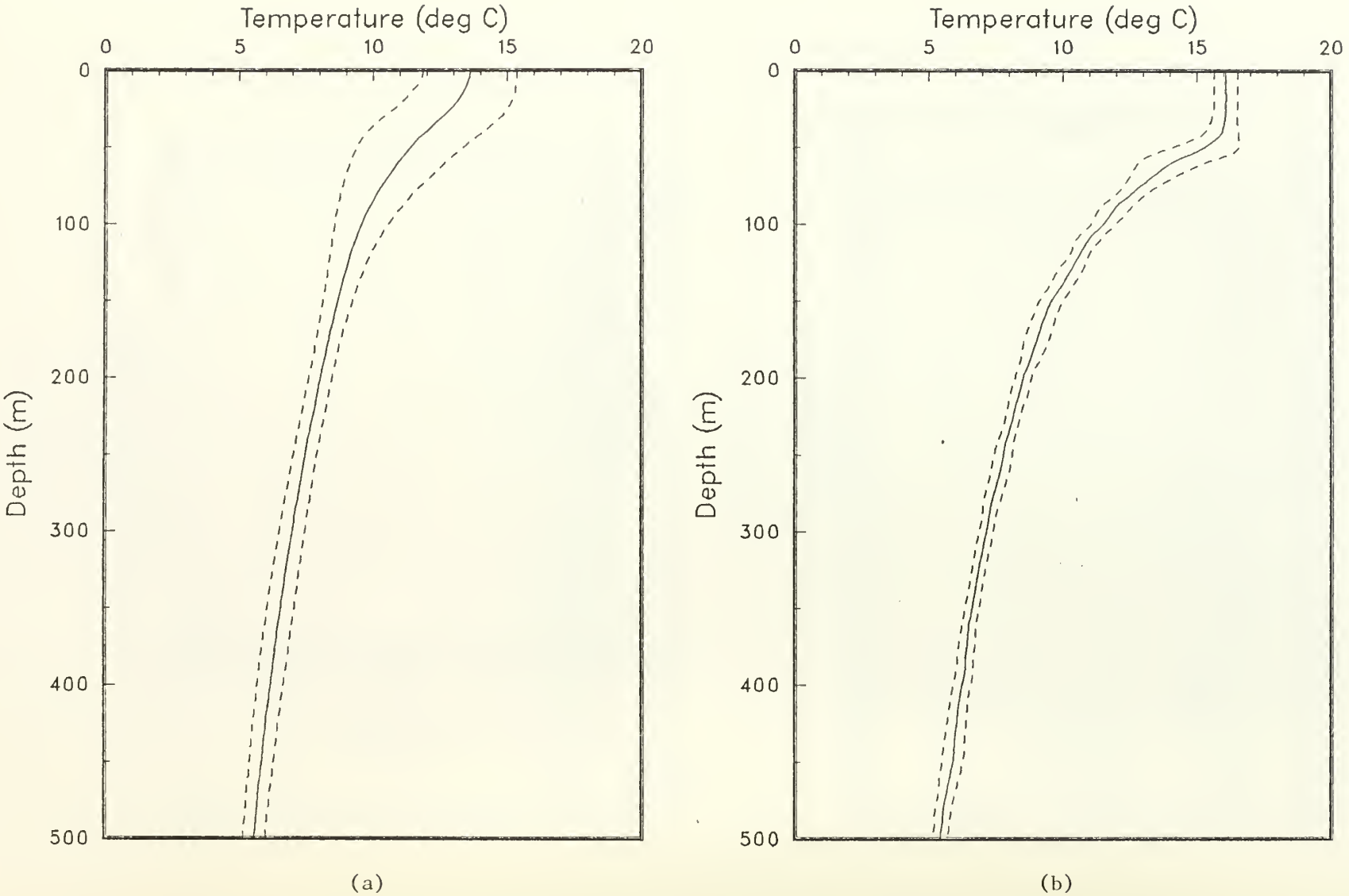

Figure 8: Mean temperature profiles from (a) XBTs and (b) CTDs with + and - the standard deviation (OPTOMA22).

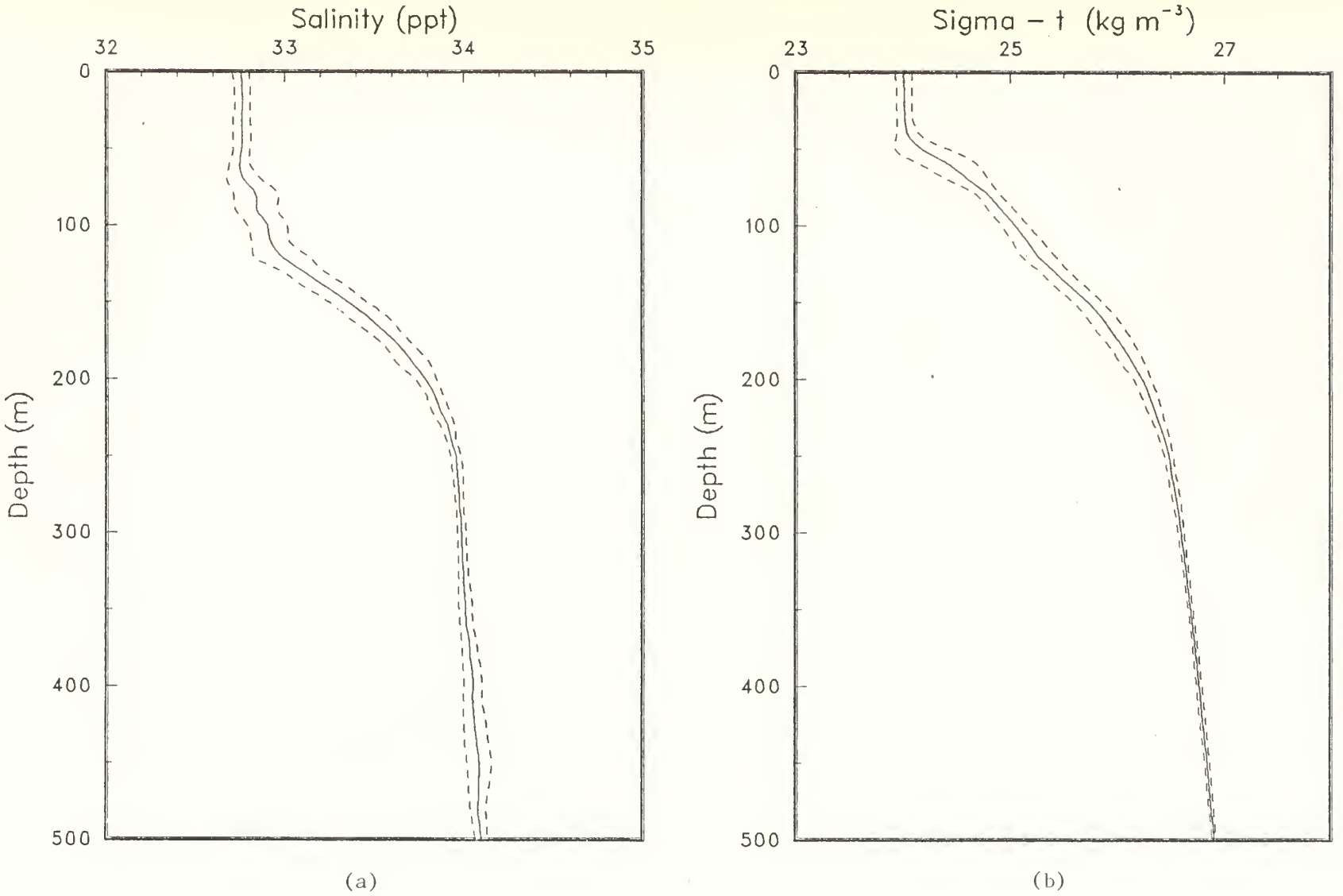

Figure 9: Mean profiles of (a) salinity and (b) sigma-t, with + and - the standard deviations, from the CTDs (OPTOMA22).

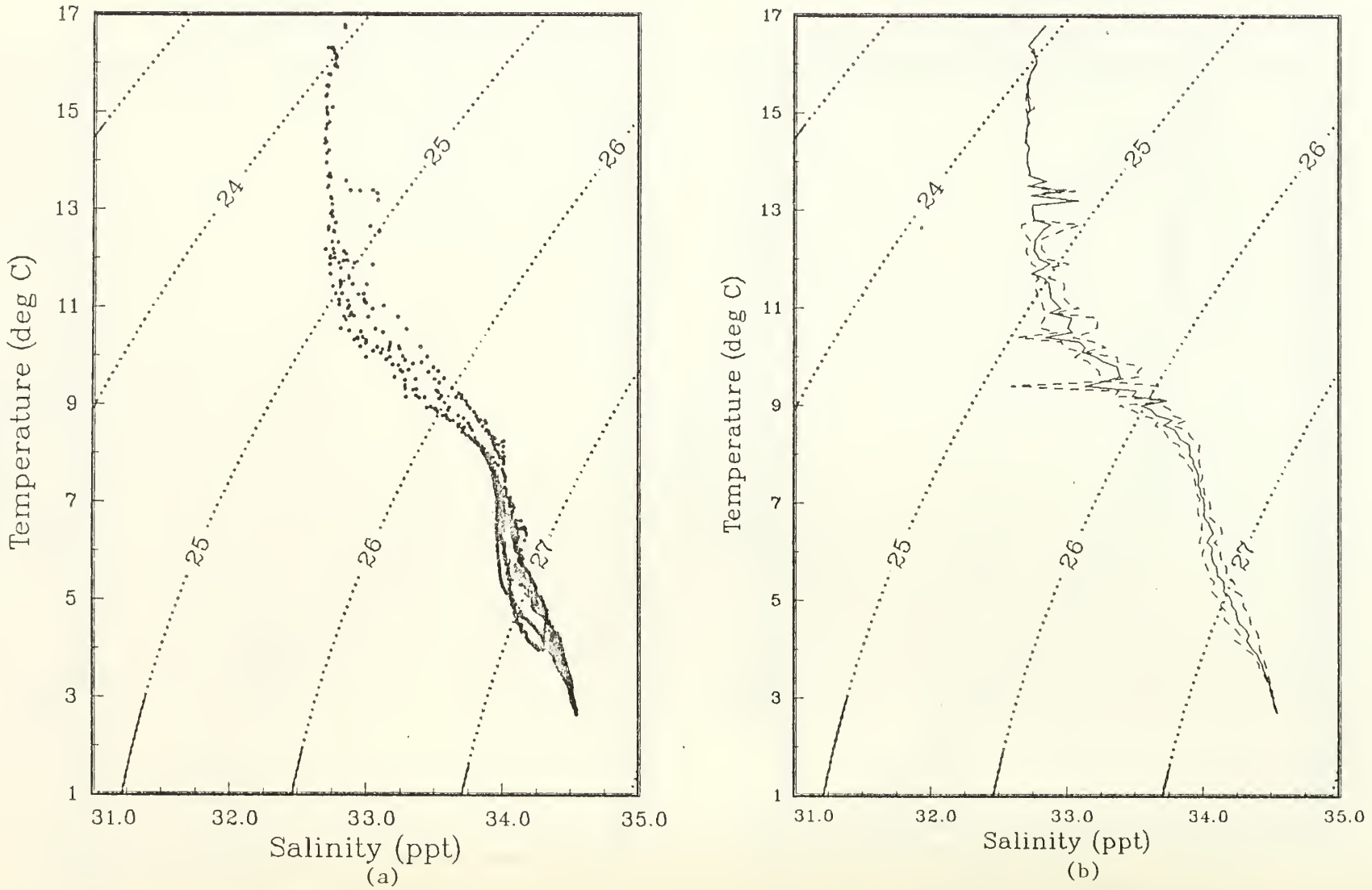

Figure 10: (a) T-S pairs and (b) mean T-S relation, with + and - the standard deviation, from the CTDs. Selected sigma-t contours are also shown (OPTOMA22).

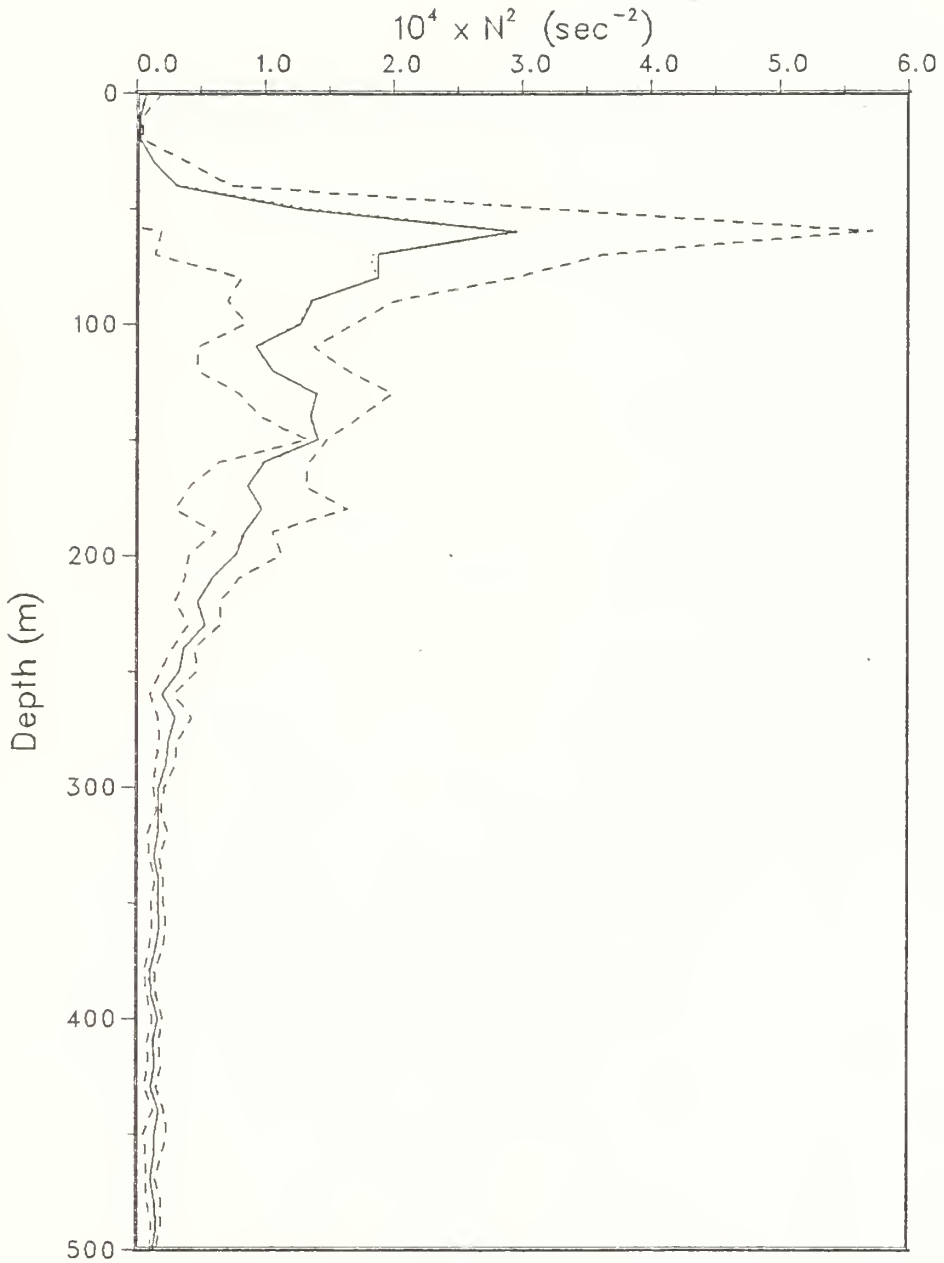

Figure 11: Mean N^2 profile (——), with + and - the standard deviation (----). The N^2 profile from T(z) and S(z) is also shown (····) (OPTOMA22).

ACKNOWLEDGEMENTS

This research was sponsored by the ONR Physical Oceanography Program. The success of the fieldwork was strongly dependent on the competent, willing support of the Captain and crew of the USNS DE STEIGUER. Members of the scientific cruise party were:

Dr. Gordon W. Groves, Chief Scientist, NPS
Ms. Melissa Ciandro, Watch Chief, NPS
LT Michael Beasley, USN, NPS
Mr. Anthony Campbell, NPS
Ms. Christine Fredrickson, NPS
Mr. Richard Tharin, NPS

REFERENCE

Lewis, E.L. and R.G. Perkin, 1981: The Practical Salinity Scale 1978: conversion of existing data. **Deep Sea Res., 28A**, 307-328.

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